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ECONOMIES AND PROFITS OF STREET PAVING.

A MISGUIDED progressive spirit in ambitious cities too commonly takes for its object the acquisition of wealth rather than physical improvement, thus repeating in a large way the deplorable mistake which has become so generally characteristic of the lives of our business men. The ultimate effects can hardly be expected to be less injurious to the city than to the individual. This lamentable misdirection of good energy we find in the work in smaller cities of many organizations whose ostensible object is the promotion of public welfare, who, proceeding upon a doubtful theory, believe that more is gained from the acquisition of a new industry than from such improvements as are needed for the most satisfactory and least expensive conduct of the business they already have. Better appreciation of essential conditions for progress, aided by the discovery that they have something to do with prosperity, has led in recent years to the formation in many American cities and towns of organizations having for their object the creation or stimulation of sentiment favorable to public improvements. These associations, known by various names and some of them composed of both men and women, have done good work in overcoming the rule of that rather common kind of conservatism which is hopelessly blinded by consideration of immediate cost in dollars and cents. Changes in methods of municipal government, depriving too conservative citizens of obstructive power, have had to be made in not a few instances before public work generally believed to be needed could be proceeded with; in many cities this relief is still needed. Despite the non-progressive, however favorable, legislation, urgent needs and growing prosperity, combined with various influences, all aid-

ed by persistent agitation through newspapers, have given an impetus to the movement for better streets, which, within a few years, has brought into existence pavements of many kinds, in the aggregate thousands of miles in length, and has projected before the public one of the most perplexing problems remaining to be solved acceptably to the 15,000,000 people who are directly concerned in a financial way.

The average annual cost of construction and repairs of the 10,865 miles of streets reported as having been paved during the ten years preceding the last census was $25,256,551. It is presumable, especially in view of a general knowledge of the streets of the principal cities, that a very large per cent. of this expenditure was for repairs and for gravel, broken stone and bowlders. Pavements made of better materials than these, in accordance with the methods now most approved, would have cost for the length of streets reported in the census, more than double the amount of the expenditure during the last decade. It is, therefore, probable that less than one-third of the streets in cities of more than 10,000 population are well paved. Without attempting to be exact, but with some care to keep my calculations well within what are believed to be safe limits, the assertion is ventured that if the construction of new street pavements proceeds as rapidly as there is some assurance for expecting, the cost for the present decade will amount to $60 for every inhabitant of the American cities which in 1890 had a population of 10,000 or more. There are many things that properly should be, but have not been, taken into consideration in this calculation, such as the growth of cities and consequent extension of streets, and the vast amount of paving that may be done in municipalities having less than 10,000 population, all of which will add largely to the estimated expenditure. As the cost of street paving is paid by the owners of abutting property in most cities, the municipalities paying from the general tax revenue only for the space covered by street intersections and for the proportion chargeable to public property, the cost largely falls directly on real estate, and if paid by one person in five, either as owner or tenant (the latter by increased rental), the average for those who must pay the expense is $30 a year for a decade, though these figures should be multi-

plied—in a ratio, however, not easily determined—if applied to business streets.

Many people can only be induced to incur large expense for street paving by well-founded prospects of gain from it. They regard it as they would an investment. Though it is no less desirable when viewed independently of these very practical considerations, it may well be subjected to such tests of value. Its paying qualities are, to some extent, capable of demonstration. Its economies may be indicated by comparisons of the cost of transportation, of relative wear and consequential loss, and of maintenance of paved and unpaved streets. While there are wide differences in the resistance to traction of asphalt, wood-block, brick and granite block road surfaces, the average, where the streets of a city are paved in about equal proportion with these materials, is less than one-third the average resistance on the streets of a city having only macadam, cobble-stone, earth and sand road-surfaces in about equal proportion. As one horse can, therefore, draw for ten hours three times as heavy a load on streets of the first class as on those of the second class, there must be an average saving of two-thirds in the cost of all transportation by means of animals and vehicles where paved streets are used. In other words, the city with well paved streets will get at the same cost three times as much service as one with streets that are not well paved.

The possible gain from this in dollars and cents is indicated by the statistics of freight transportation. In the year 1890 the railways of the United States moved 701,344,437 tons of freight, which was probably hauled over roads or streets at the points of loading and unloading the cars an average distance of half a mile each way. As a load weighing a ton can not be transported a mile by means of animals and vehicles for less than forty cents, which will be used in this calculation as an average charge, the street haulage of the freight moved by the railroads of the United States in 1890 must have amounted to about $280,537,775.80. It will be assumed, however, at the risk of being much too liberal in a tendency to underestimate, that the average street haul was only a quarter of a mile each way and that the cost was, therefore, $140,268,887.40. A saving of two-thirds of this sum would carry to the credit of the economy account of street paving $93,512,591.60 a year, or, with-

out making any allowance for the annual increase of traffic, $935,-125,916 in ten years. The freight moved by the railroads, it is supposable, was carried largely into or from the 225 cities which constitute the principal markets or distributing centers of the country, but after all, railroad freights represent only a portion of the street hauling, doubtless much less than one-half, so that after much trimming, we are brought at last to the conclusion that the cost of street traffic, largely in cities of more than 10,000 population can be reduced $187,025,183 a year, or $1,870,251,832 in ten years, which, with interest at the rate of five per cent. per annum, would make a total saving in a decade of $1,963,804,423.50, which would pay for 28,044 miles of street paving at a cost of $70,000 a mile.

The distribution of this saving is, of course, general. There is much to be added, however, which will help the apportionment of savings. There are in the cities of the United States having over 10,000 population more than 600,000 horses—estimating one for each twenty-five inhabitants—used for driving purposes. It will cost not less than $100 a year to properly feed each of these animals. Experience has demonstrated that to keep them in equally good condition they must be fed one-fourth more when driven over unpaved streets than when they travel the same distance over a solid, nearly level surface. Good paving will, therefore, make a difference of about $15,000,000 a year in the cost of the subsistence of these horses.

The best obtainable statistical information indicates that there are 400,000 vehicles in daily use for riding purposes in these same cities. Tires, spokes, springs, rivets and all the parts of a vehicle which are strained by the resistance to traction of a road surface will last twice as long in service on good pavements as when in use on rough roadways. The average yearly cost of repairs and the loss from wear of a vehicle will amount to about $25, or, in the aggregate $10,000,000, which good paving would reduce to $5,000,000, making the total annual saving from subsistence of horses and repair and wear of vehicles, all by means of well paved streets, $20,-000,000. When interest at the rate of five per cent. per annum is added, we find that the saving to the owners of horses and vehicles,

used for driving purposes, is sufficient, if made a special tax, to pay for 350 miles of street paving each year.

As a contribution measured by the value of possible benefits this, however, would be insufficient, as it leaves out of account a large saving of time, from which there must be some pecuniary gain and increased pleasure and comfort, worth some consideration, but all taking a range beyond trustworthy approximation. The relative saving on the same items, in general street traffic, to such extent as it may be within reach of special taxation, would be much larger.

It should be understood that in speaking of the use that could be made of the resultant economies of good streets, if converted into a fund, the levying of a special tax as a means of paying for new payments is not proposed. There are strong reasons why there should be a special tax on horses and vehicles in cities, but it is preferable that the revenue from this source should be used to keep the streets in good condition after they have been paved. If a tax is levied for their use it can properly be on a basis of rental only. It would be not only inexpedient, but unreasonable and unfair to compel the owners of horses and vehicles to pay the entire cost of new pavements, which confer benefits traceable in other ways where value can be measured with about equal certainty.

It so rarely happens that abutting real estate fails to derive from a paved street an increased value exceeding the cost of the improvement, that the exception is worthy consideration only as a possibility, if the certainty of direct profit to the person who must pay the assessment is taken into account. In the measurement of increased value there is a wide range, the degrees of which proceed from various influences, some of them speculative, yet street paving is as unfailingly productive of gain as anything that affects the prices of real estate. It has been known to bring within a year's time a profit of 2,000 per cent. Often where the advantages are not off-set by the paving of neighboring streets, the gain on the investment (counting the cost of the improvement as such) is from 100 to 200 per cent.

In seeking information for a trustworthy calculation of the average value of paving to owners of abutting property, I sent letters to men who have been long engaged in dealings in real estate

in eighty-five American cities, asking from each an exact statement of the comparative selling prices per foot of frontage of land on paved streets in their respective cities and on parallel streets, unpaved, but both otherwise alike in character. Opinions as to the usual enhancement in value of abutting real estate by street pavements were also solicited. The answers, while lacking the requisite uniformity for tabular classification, have a well sustained significance—complete, in fact, with but a single exception, in indicating that abutting real estate derives from street paving an increased value exceeding its cost. The exceptional instance was a city in New York, where, it was stated, there had been a depreciation in the selling value of property, which, however, was attributable to causes having no connection with street paving. The reports received from other cities showed that the selling prices of real estate on paved streets were from $15 to $300 per foot of frontage higher than on parallel streets unpaved. In the inquiries which elicited this information the request was made quite distinctly that comparisons of values should be made only on streets alike in general character, except as to paving, and to this, as the primary or main cause, the differences in prices are attributed, though there are doubtless other influences combined with it and inseparable from it. The increase of values is largest in cities where there is little other equally good paving, the estimate ranging from 200 to 300 per cent. on the cost of the work, with cumulative tendencies after the second and third years, if other neighboring streets are not similarly improved.

In cities where paving is not restricted to a few streets the consequent enhancement in the price of benefited real estate becomes relatively less than where its limited use makes it more conspicuously advantageous, but while the percentage of profit diminishes with the extension, paving becomes more essential as an inducement of sale, and the absence of it also causes a depreciation largely more than its cost. In cities where there is the greatest activity in the transfer of real estate ownership, as, for instance, in Chicago, the property on unpaved streets otherwise comparatively unobjectionable is the least salable. So essential are pavements to the sale of lots in new districts that they are regarded as an indispensable inducement to buyers, and those who are most successful in dis-

posing of new plats of real estate, at profitable prices, do not expect purchasers until they are prepared to show paved streets and walks for the immediate use of prospective home-builders; yet it should not be understood that street pavements have little realizable value in cities where they are in general use other than in helping the sale of abutting property. It is a well established rule that the amount expended for such improvements shall be added, with interest, to the valuation of the property bearing a proportion of the cost. As it obviously becomes at the same time a salable inducement, the prospect of adequate returns to those upon whom the expense falls is well assured. But there may be reasonable expectation of more than this, even in those cities where paving comes into such general use that it confers the least of special advantages upon the property contiguous to it. In Chicago, to which reference is made because it has been mentioned in connection with a relative point, there are indications of this, notably on the principal residence streets. As an instance, on Prairie avenue, between Sixteenth and Twenty-second streets, where the paving is good, the selling price of real estate is reported to be about $700 per foot of frontage, while between Twenty-second and Twenty-sixth streets, where the roadway is not in approvable condition, the prices are as low as $300 per foot, and between Twenty-sixth and Thirty-first streets, where the pavement is the best on the avenue, they rise above $700. Many instances of this exceptional character indicating the possible profits of paving, might, if cited, be misleading; it is quite enough to add that the lowest estimate of the enhancement in the price of real estate by street paving in a majority of the cities from which such information was received, was at the rate of $10 per foot of frontage, which, if assumed to be a fair average, would add $105,600 to the value of the land on either side of every mile of a street on which a modern pavement is constructed. The cost of the paving which would cause this increase in the value of real estate would not exceed an average of $70,000 a mile if forty feet in width; on narrower roadways, or, where the cheaper materials are used, it may be between $40,000 and $50,000 a mile.

Calculations as to the economies involved in the problem fall somewhat short if there is not taken into account the tractive facilitating advantages of different kinds of pavement; this saving em

braces both time and wear, which lead into figures amazingly large. It may be enough to say that the ratio of difference is between 30 and more than ten times 30 per cent.; this may all be thrown in for good measure. Then comes the saving in maintenance, along with large differences in the cost of cleaning, an expounding of which would lead into the consideration of relative merits of various systems and it is not the purpose of this article to do this further than to connect the idea of economy and profit with the maxim, well recognized in other relations, that "the cheapest is not the best, though the best is often the cheapest."

Gravel, planks, coal cinders, cobble-stones, and the many other materials used in various forms during the last fifty years in temporarily strengthening the surface of roadways have been inexpensive, but not sufficiently serviceable, and, only as the slow gradations of increasing cost have become less objectionable, after the successive failures of cheap experiments, have paving methods improved, with results that have demonstrated that in the end they are at once the most economical and profitable. A road surface of broken stone, constructed in accordance with the macadam specifications, will cost in the first year but a small part of the amount that must be paid for granite blocks on a concrete foundation, but the maintenance of the macadam surface, if repairs are made when needed, will in the end, under about equal use, largely exceed the total cost of the more serviceable pavement. It should not be understood, however, that the most durable is advocated as preferable always to that which at first is cheaper. There are many streets to which the macadam surface would be better suited than the granite block pavement, not on account of superior qualities, but because it would at a cost more nearly commensurate with its service meet the requirements sufficiently. These different conditions would not, however, admit like consideration of some other cheaper kinds of paving, which are lacking in qualities quite as essential as durability. If the material combining the merits of wearing longest and costing least were the most desirable there would be no need to look for anything better than the cobble-stone, but those who have suffered the torture of jolting rides over bowldered streets will doubtless prefer no pavement at all as more merciful to man and least, and as less destructive if not so durable.

Several kinds of paving, which at the present time receive more

or less approval, have to some extent peculiarly suitable uses, and it is also strangely true that there is no one kind adequately adapted to all the requirements, notwithstanding the arguments to the contrary, presented by those who have unlimited faith in their own preferences or that which best represents their interests. All are products of the experimental stages of this work, the processes of which have not yet evolved the perfect pavement, though possibly they may in the future.

The character and requirements of a street are to be first considered in determining how or with what materials it should be paved. A thoroughfare where travel from other streets converges should have such a surface as will best facilitate the movement of vehicles, wear the longest without repair, and be most easily cleaned. A street used chiefly for heavy hauling should have a pavement which, while presenting as little resistance as possible to traction, will have the most durable qualities. A residence street, on which there is much driving, should be paved with the materials which will give the smoothest surface, cause the least noise, and afford the best protection against unsanitary conditions. A street of similar character on which there is less travel, should have about the same qualities in its paving, except that equal aid to traction would not be required. Suburban streets and those so remote from the main lines of travel that they are used comparatively little, should have like treatment, but it may be made adequate in lighter form. These distinctions as to the most essential requirements for streets of varying character would permit the use of different kinds of materials, each peculiarly suitable, and it is believed preferable, though there could be some restriction of selections, without cause for dissatisfaction. Suitability would be determined by compliance with the common demand for the lowest requisite expenditure of money, while the cost would be measurably proportionate with the service and the realizable value of the improvement to those who would be compelled to pay for it. A comparison of the qualities of the different kinds of materials, and an approximate knowledge of the cost of each, which may not be precisely the same in any two widely separated localities, will enable any person to decide what paving suits a particular street with less danger of making a mistake than in following general recommendations which possibly might not be applicable in special instances. *William Fortune.*

COHESIVE STRENGTH OF ASPHALTS.

If it can be demonstrated that the function of an asphalt cement in the composition of an asphalt sheet pavement is the same as that of hydraulic cement in pavement surfaces made with it, one can readily perceive that we command a measurable physical quality by the help of which to determine the comparative excellency of an asphalt for such use.

The writer is not prepared to accept as true such an hypothesis of the function of asphaltic cement, but awaits conviction. He has made several thousand tests of the cohesive strength of asphalts in their crude, refined and cement conditions, including also various fractions of asphalts, and of asphalts freed from insoluble impurities such as coke, sand and clay.

If asphalt for paving could be specified as requiring a certain cohesive strength per square inch, the disputes and conflicts arising in the competition of the business would be very much lessened, *possibly*. It is desirable to have an expression of opinion by parties interested in this matter, and some general agreement as to what degree of strength should be demanded in specifications, that is, of course, if that physical property affords a valuable index of the merits of an asphalt for paving uses.

Suppose the requirement be made that an asphalt cement shall possess a strength before breaking of not less than 1,000 pounds to the square inch area, at the temperature of 59° F. and of 100 pounds at 120° F. How many asphalts are available for competition and is that degree of strength too high or too low.

Dolphus Torrey. Biographical sketch in April Number, 1893, page 195.

The writer tests pieces having an area of one-eight of a square inch, and has obtained results even higher than that suggested, and purposely avoids naming the kind of asphalt used to avoid all questions of propriety as to influencing commercial interests. *Dolphus Torrey.*

SEWERS FOR SMALL CITIES.

A GROWING town or a small city can not long dispense with sanitary sewers, as the disposal of wastes properly require them. To the lack of popular knowledge of the sanitary necessity, convenience and economy of sewers, is attributable most of the opposition to their construction. The designing of a system of sewerage is often complicated and requires special treatment in each case. The objection to using streams and rivers for disposal is, in many places, fatal, and methods of purifying sewage are required. Chemical, broad or intermittent filtration are used, the first being generally too expensive for small cities, while the second is less costly and can be made nearly as effective. The question of combined or separate systems for small cities is now quite positively decided in favor of the latter. It is not necessary to repeat the well known arguments used by advocates of each system. The system now designed for nearly all cities of moderate size, and often of large ones, is based on the plan of providing for house drainage almost exclusively. Subsoil drains are sometimes connected, and where found necessary or expedient, storm water is admitted.

The best results are obtained by cities when they can secure a well designed system covering the entire present and prospective area, if possible, with outfall so placed that no nuisance or injury to water supply can result. If storm water sewers do not empty into large streams, it is a good plan to have an intercepting sewer intercept their dry weather flow and carry or connect it with the outfall main of the sanitary sewers.

The necessity of securing good work at minimum cost is especially applicable to small cities, where the burden of public improvements is most seriously felt. In order to secure this object, the plans and specifications must provide for the necessary work at the least cost. As illustrations of the contrary, the following is given: In a city of some 5,000 population, a main sewer of brick was constructed, one and one-half miles in length, with a uniform grade and section throughout. The unnecessary expense of such construction was considerable, as the upper end of the sewer did not receive but a slight portion of the drainage as compared with the lower end.

Even larger cities are constructing sewers without a complete system to work from, the work being designed in piecemeal and consequently defective—some sewers too small, others too large. The construction of brick sewers is often unnecessarily expensive. A prominent engineer specified English Portland cement for a brick sewer throughout; the sewer committee of the town were persuaded to change the specifications to American hydraulic cement and saved several thousand dollars thereby, while the work was practically as good. The question of a single or double ring brick for various sized sewers is not decided, at least not in practice. Considering strength alone it is perfectly safe in firm soil to construct good brick sewers of 3 to 3½ feet in diameter, with a single ring, and, as shown by report from South Bend, Ind., sewers of 4 by 5½ feet have been constructed and have stood for years. With these facts it seems extravagance to use 2 ring brick on sewers of 2 feet or even 2½ feet diameter in good soil, as is done in places. The difference in cost is from 15 to 25 per cent. of the entire cost of the sewer, and unless some great advantage can be shown by using 2 rings, the extra expense is unwarranted.

In soliciting bids for sewer work, prices per lineal foot for various sizes are requested regardless of the character of the excavation, which the bidder is required to determine for himself. In some instances, however, bids are required for rock excavation. In case the engineer has made an estimate of the amount of rock, a just comparison of bids can be made, but much contention between the engineer and contractor can be avoided by adopting the first and more general method. Where bids for rock excavation are requested, and no amount specified, as was the case in a large sewer contract lately awarded, injustice was done to both city and the actual lowest bidder. The party securing the contract bid lowest on sewers, but high on rock excavation, namely, $5 per cubic yard, the other bid was somewhat higher on the sewers, but only $1.15 for rock. From actual knowledge of the amount of rock in the work, the city will pay at least $10,000 more than if it had awarded the contract properly.

Where an unsafe foundation is anticipated, it seems proper to provide in the specifications that all extra material, such as brick, plank or concrete ordered to be used, in addition to what the plans

call for, should be paid the contractor at a different figure determined by the engineer in charge. This is generally done, but its omission occasions uncertainty in the minds of bidders, and can be made an unfair burden to the contractor.

Frequently it is found preferable in the case of a very wide street to place a lateral sewer along each side of the street for convenience of house connections being more economical than one central sewer. The plan, however, of placing a lateral along side a main sewer, or above in the same trench, I consider both unwise and a useless expense. No harm is done to main sewers by proper house connections, if y's are placed where needed, and if the main sewer is considered too deep, or in a rock cut, I would advise carrying up house connections from the side of the main sewer, in the same trench, nearly vertically until a proper height is reached.

The question of the maximum size of tile pipe for sewers is not settled. Practice limits it to 21 inches. Many cities specify brick for sewers over 15 or 19 inches in diameter. The cost of a 24-inch brick sewer is less ordinarily than that of a 24-inch tile, but when care of construction, increased flow, less sediment, and more imperviousness are considered, we find the majority in favor of the tile. Great care, however, is required in securing the best material, and in laying them.

The great advance in sewer construction during the past decade is due to the fact that communities become aware that in order to prevent disease the air, earth and water around them must be kept pure, and also that it is no longer necessary and not even preferable to construct sewers for home drainage large enough to carry all the rainfall which, however attempted, they seldom do. The difficulty of chemically or otherwise purifying such immense volumes of mixed sewage and storm water, when necessary, has given a great impulse toward the construction of separate sewerage systems. When sewage is not received sewers can be made shallow and less expensive. Small cities have thus become active in sewer construction, which, if confined to actual necessity is never burdensome.

Nothing is more injurious and unreasonable than for small cities to endeavor to construct an entire sewer system at once. One case occurs to me where a small town attempted to build ten miles, partly through corn-fields, where one mile was sufficient. Injunctions, however, prevented its folly. *M. Tschirgi, Jr.*

THE TESTING OF PORTLAND CEMENT.

THE adoption of more rigorous rules for testing Portland cement is to be desired, for the protection of engineers and architects, and to encourage those whose efforts are to give to the trade a more valuable product. The first point to be considered is the fineness of grinding. For this test three sieves are necessary, Nos. 50, 80 and 200. Weigh accurately 100 grammes of cement. Pass it through the finest sieve (No. 200); the residue, being weighed, will give at once the percentage upon the sieve. What passes through a No. 200 sieve is the impalpable portion of the cement. The residue on No. 200 sieve is then thrown on a No. 80 sieve, and what is left, being weighed, constitutes the percentage of residue upon sieve No. 80. The residue on a No. 80 sieve is finally thrown on No. 50. What can not pass through this sieve is weighed, and constitutes the percentage of coarse grains in the cement. A well made Portland cement will leave nothing on a No. 50 sieve. The residue on No. 80 will be from 5 to 7%, and from 25 to 30% on No. 200. Some brands of Portland cement will leave from 15 to 20% of residue on a No. 80 sieve, and from 40 to 50% on No. 200. Those cements should be rejected. The inspection of the residue will indicate the quality of the cement. The presence of particles of coal shows that the selection of the clinkers has been carelessly done. Soft yellow grains show that under-burned clinkers have been mixed. The residue should be composed of nothing but hard black grains with sharp angles.

The specific gravity of Portland cement is between 3.050 and 5.175. It can be determined very accurately with various apparatus. The sample should not be sifted beforehand, but treated as it is. The presence of foreign matter, even in small amount, can be at once detected by the specific gravity test. The most common adulteration is to add slag to the cement. But as the density of slag is only 2.8, it follows that an objectionable proportion of slag in the cement would lower its density below 3.05, which should be considered the lowest that can be tolerated.

As to chemical composition, it is advisable to have the cement analyzed, as it will give valuable information on the product. An-

alyses made from English, American, German, French and Belgian cements show that the quantity of each element varies between the following limits: Silica, 20.50 to 26.10%; alumina, 5.20 to 10.60%; oxide of iron, 2.10 to 5.30%; lime, 51.20 to 67.31%; magnesia, 0.33 to 2.80%; sulphuric acid, 0.26 to 1.78%. The degree of hydraulicity, which is determined from the chemical composition, is the first thing to be considered. The relation between the silica and alumina on one hand and the lime on the other constitutes what is called the "degree of hydraulicity." It should not be below 0.43, and when the cement is to be used on work in sea water it should be raised to 0.46. Oxide of iron should not exceed 4%. In some specifications a higher percentage of oxide of iron is considered unsafe. Magnesia must not exist beyond 3%; any cement having more should be rejected. Magnesia cements give very good results in tensile strength, and work done with them may look very well for several months and even several years, but in the course of time swelling takes place, and with such force that nothing can resist it. Even 1% of sulphuric acid would be dangerous if the cement was used in sea water. In soft water or in the air, however, the presence of 2 or 3% of sulphate of lime has no injurious results.

The initial setting of Portland cement, gauged neat, should not begin before 30 minutes, and the final setting should not take place before three hours. In the case of imported cements, which may be from three to twelve months old, it will take sometimes 12 hours, or even more, before the sample gets hard. A more freshly made cement will usually set in four to seven hours, and this is more satisfactory. Of all the qualities in cement the setting is the most difficult to regulate. A carefully made cement may sometimes be very quick setting, while an inferior cement may be very slow setting. Nevertheless, slow setting is almost essential in Portland cement, and manufacturers can always, in the case of a well-made cement, make it slow setting by exposing it to the air in thin layers.

The test for stability in volume is an important test, and should never be omitted. Briquettes or cakes of pure cement, 24 hours after gauging, are immersed in boiling water; if the samples show no alteration at the end of six or twelve hours, the cement may be considered perfectly safe. A dangerous cement will disintegrate or blow. The test for hydraulicity in cold water is no longer consid-

ered reliable by experts. Boiling water will bring out in a few hours the effects of free lime. An excess of sulphate of lime may also cause the disintegration of the cement, especially in sea water. A solution of calcium chloride at 40 or 60 gr. of anhydrous salt per litre should be used to mix the cement, and the samples immersed after 24 hours in the same solution. If the cement contains from 3 to 4% of sulphate of lime, at the end of a few days the samples will show signs of cracking.

For tensile strength briquettes of one sq. in. section are almost universally used now. The quantity of water mixed with the cement has much influence on the tensile strength. An excess or a deficiency of water is equally injurious. The proportion of water to be used may be from 20 to 30%, according to the nature of the cement. The paste ready to be put in the molds should be stiff, brilliant and plastic. The 24-hours' test has no value. Briquettes are broken at the end of 7 and 28 days. Neat cement should stand at least a strain of 400 lbs. without rupture at seven days and 500 lbs. at 28 days. It is not uncommon to see certain brands giving much higher tests. Portland cements of superior quality, when tested neat, show a rapid increase in strength, and the maximum (from 800 to 900 lbs.) is attained in a few weeks or a few months. Cements of inferior quality test low in the first period of hardening; they may increase in strength, in the course of time, but they will never test as high as the best. It is preferable in practice to use cements which set slowly and harden rapidly. The work is thus in a short time protected against deterioration. The greater the initial strength the surer the success of the work. Cement is never used neat, however, and the strength of a neat briquette after a long time presents but little interest. The strength of cement mixed with sand is much more important.

To test the tensile strength, a mixture in equal parts of sand and cement will attain the same strength as pure cement; and even with some sands of good quality the mixture would test higher than neat. If a sand briquette is immersed in water for a few days only and then left in the air the tensile strength will be considerably higher than if the sample had always been under water. The same results occur in practice; and all masonry works should be, as far as possible, kept wet during the first few days. For the sand test a stand-

ard sand, made of crushed quartz should be used. The mixture of three parts of cement to one of sand, by weight, has been adopted everywhere, and should be adhered to for the sake of comparison. Much difference of opinion exists as to the amount of water to be used and the manner of filling the molds. In Europe the official rules prescribe generally 10% of water. A sufficient quantity of mortar to fill one mold is weighed, and this is pressed firmly with a guide and a hammer until the water appears at the bottom of the mold. In America, a little more water is used, and the mortar is filled loosely in the mold. There is no compression of the mortar except what the operator may apply with the trowel. The object of the European mode of testing is to bring out all the strength there is in the cement, and to do so by mechanical means, which are constant and independent of the skill or experience of the operator. The results of this method agree very closely. The American system of testing comes nearer to the practical use of cement, and engineers give it the preference on this account. But by this method the sand tests differ widely, and it is difficult to form an accurate opinion of the comparative value of a given brand. A mixture of three parts of standard sand to one of cement, under the American mode of testing, should give a minimum tensile strength of 125 lbs. in seven days and 175 lbs. in a month.

Elaborate and expensive apparatus is used in Europe to estimate the crushing strain that cement should stand, and in the official specifications the results of this test are considered more important than those from tensile strength. Tests are also made for bending strength with a bar made of mortar, having a standard length and section; for imperviousness, by means of water pressure; for adherence, with blocks of mortar on marble or glass plates. But these tests have not yet been adopted in the United States, and they offer no particular interest, except for special researches.

Pierre Giron.

CURRENT INFORMATION.

A CONFERENCE OF BOARDS OF PUBLIC WORKS.

The political control of American municipalities which brings about changes of administrations from time to time, puts to a disadvantage men who, on account of personal popularity and representative character, are called to fill positions requiring technical knowledge and experience for the proper performance of duty. This is especially noticeable in the direction of public works. It frequently happens that men of unquestioned ability in their own business are not prepared to meet the demands upon them in the beginning of their public responsibilities. If conscientious, they gravely feel the need of knowledge they have had little or no opportunity to properly acquire. In private business they would hesitate to assume such exacting duties without thoroughly familiarizing themselves with the work before them to avoid falling into serious mistakes. Public business is not different from private business in the essential requirements of knowledge and experience. It can not be successfully administered when these qualifications are lacking. Public officials are conscious of this more generally than the people whom they serve recognize or reasonably take into account in their expectations.

Even those who have had years of experience and who have devoted themselves assiduously to gathering knowledge pertaining to their duties, feel the need of an interchange of ideas with others equally well informed. There are indications of this in the correspondence which municipal officers are led into by their own desire for information or the inquiries of others, and the trips which are frequently made by committees who seek knowledge in cities where there has been valuable experience.

While the need of interchange of ideas in a direct way through association has been generally felt, there has been no movement toward bringing together interested people for this purpose until within the last few weeks, when Mr. M. J. Murphy, the street commissioner of St. Louis, sent letters to the mayors and members of the boards of public works in a number of cities, suggesting a meeting for the discussions of questions in which they are officially interested. These letters brought prompt responses, strongly commending the suggestion. This correspondence has occurred during the last month, and a general approval of the idea assures early action in carrying out Mr. Murphy's suggestion. Extracts from a number of the letters received by him are given below:

H. B. Johnson, Commissioner of Public Works, Syracuse, N. Y.—In my judgment your suggestion as to the feasibility of organizing a national convention of the members of the various boards of public works is a good one, and in my opinion good results would follow in consequence of such an organization. Our city of about 100,000

inhabitants has just commenced putting in a $4,000,000 water system, and a sewer system that will cover all the different portions of the city. We also have nineteen miles of pavement under contract, building and to be built. All this work is under my supervision and I believe I could get some good suggestions and ideas from others assembled in a convention such as you have mentioned. Anything that I may be able to do to help you in your efforts to bring about such an organization, I would be pleased to do at any time.

Arthur C. Harris, President Board of Public Works, Denver.—We desire to state that we most cordially endorse your suggestion that a national convention of the various boards of public works of the principal cities of the country assemble and organize into an association, whose object would be to exchange ideas and information relative to the government of each city and the methods of municipal management relating to public improvements. It is surprising that such an organization was not thought of years ago, but "better late than never," and you will deserve well-earned praise if you succeed now. There is a great awakening in the minds of those who take an interest in municipal public works, as is evident in various ways, such as interchange of views by letter between the various boards and commissioners in charge of the improvements, and the publication of magazines and newspapers devoted to such subjects as paving, sewers, roads, etc., etc. The paving question alone is a very big one, large enough to occupy a liberal portion of the time of any convention. The asphalt question of itself is no small one, as rival companies contend tenaciously for the exclusive use of their special brand. Then the use of brick as a paving material is looming up on the horizon as an interesting question. The relative merits or demerits of the various kinds of pavements compared both as to cost, length of life, expense to repair, utility, noiselessness, etc., etc. But I must desist enumerating, as the subject is too vast to enter into an enumeration in a letter on the various subjects. The sewer problem is a serious one in every town and city, both as to the relative merits of the separate and combined systems and the best manner of construction. The disposal of the sewage is interesting many of the cities now and as population increases along the rivers of the country the necessity for some other method than polluting our streams will confront us. The proper method for assessing property for local improvements would raise an interesting discussion. A comparison of the various charters, laws and ordinances governing and creating the various officers in charge of public improvements. How should the board be created, whether by an election or appointment? If appointed, by whom, the governor, mayor or city council? How long should they serve, etc., etc., etc.? The good to be done by an exchange of views on the hundreds of very important matters that would come before such a convention would be of incalculable value to every city in America and it would be a wise expenditure if each city would set aside each year an appropriation to aid the study of these subjects. If municipal management could be lifted out of the dirty pool of partisan politics, the way of the public works reformer would be easy. A convention on the lines proposed by you would, I

think, in time materially aid in the divorcement of municipal business from the political ward heeler, as the tax-payers could be shown how their money was wasted by the latter in vast sums. That "cleanliness is next to Godliness" is as true when applied to the body politic as it is when applied to the material body. In conclusion, I would suggest that the engineers of the cities and boards of public works be included in the membership of those conventions, and perhaps the mayor of the city, too.

C. H. Benzenburg, City Engineer, Milwaukee.—Almost every branch of engineering or public improvements is represented in some national organization with the single exception of municipal improvement, comprising sewerage, street improvements, the maintenance of streets and all such work as comes under the head of a board of public works, with the exception of water-works. Indeed, you are right in claiming that by a convention of the members of boards of public works and of municipal engineers, much could be learned by each and every delegate in the exchange of experiences and in the comparison of local laws and official duties. Now much of such information is being solicited through correspondence, in placing from twenty-five to thirty questions before engineers who have had experience, by those whose experience in some particular line in municipal work has been limited. I have myself from three to five such communications every week for two-thirds of the year. The field of work of a municipal officer is broader and comprises a greater variety of work than that of any special engineer, be he water-works, sanitary, bridge, electrical or mechanical engineer. Therefore, much greater opportunity is given in an organization of that kind to transmit or observe experience gathered in various places by the members of such organization. I, therefore, heartily endorse your movement, and I have no doubt that you will find sufficient encouragement to warrant the calling for such convention. If such convention is called, permit me to call your attention to the fact that, as you know from your own experiences, there are certain times of the year when municipal officers are much more busy than at other times, and therefore less likely to attend a meeting. Should you wish, you may quote my hearty endorsement of the movement you have outlined in your letter.

J. H. Winspear, Chairman Board of Public Works, Omaha.—The suggestions contained in your letter are certainly as timely as they are excellent, and should enlist the hearty support of the members of the boards of public works throughout the country. Without doubt, a national convention, such as you suggest, would prove doubly pleasant and profitable. It would serve to bring the boards into closer touch and kindle a feeling of friendship that would prove invaluable. When we witness the benefits that come from the national organizations of superintendents of building, chiefs of the fire and police departments and kindred organizations, and see the large attendances at the annual gatherings, the conclusion is naturally drawn that good comes therefrom. No other department of the municipal governments can derive one-half the benefits by a national gathering and the dissemination of knowledge that would follow, together with the interchange of ideas and experiences, as would the members of the department of pub-

lic works. By all means let such a convention be called, and the members of this department unanimously indorse the movement.

Letters commending the suggestion and promising co-operation in the movement have also been received from Mayor Stuart, of Philadelphia; President Ross, of the board of commissioners of Washington, D. C.; Aaron Kohn, chairman of the board of public works of Louisville, Ky., and the board of adminstration of Cincinnati.

These letters fairly indicate the feeling among municipal officers regarding the proposed meeting. The movement is important, and Mr. Murphy has performed a great public service in starting it.

A call is now being prepared by him for the proposed meeting, and will be issued soon. It is Mr. Murphy's idea that the meeting should not be held earlier than sixty days after the issuance of the call.

It has not yet been decided where the meeting will be held, but it is not improbable that St. Louis will be the place. We are in receipt of letters from some of the boards of public works in the west, however, favoring other cities, from one of which referring to Buffalo, N. Y., we quote: "The city is so situated as to be accessible from all parts of the country, and its climate during the heated term would add greatly to its charms and the comfort of the delegates. It is an indisputable fact that the city of Buffalo is the possessor of one of the most perfect and magnificent systems of public improvements in the country, and much valuable knowledge would be acquired by a personal investigation of the same. Another interesting point is the harnessing of the great Niagara for power purposes, and its inspection would prove instructive and delightful. We believe that by selecting Buffalo a great number of cities would be represented, and that the different sections of the country would be brought into closer touch. We of the West feel that we would reap great benefits by going as far east as Buffalo, and are willing to meet the Eastern delegates more than half way in the selection."

THE GOOD ROADS MOVEMENT IN NEW YORK.

Mr. John A. C. Wright, secretary of the New York Highway Improvement Association, whose intelligent and zealous efforts in organizing and directing the good roads movement in New York have attracted general attention, recently submitted a report of what had been accomplished in his state during the last year, showing the work done in different counties through local organizations. In a general statement regarding legislation he said:

"In regard to legislation, as is well known to you, the county optional law was passed last year, and also the experimental road building law in Clinton county by convict labor. At the end of the session there was also a law passed providing for a highway manual of the state of New York. This has obviated the necessity of any pamphlet of that nature, provided for by the Utica resolution, to be printed by our league.

"The experiment of convict labor proved itself there a success, as appears by the report of the superintendent of the state prison, and Mr. Fish's bill providing for such road-making in the neighborhood of all the prisons of the state has passed the legislature at Albany and will probably receive executive approval. Prof. Collin, of the statutory revision commission, at the

suggestion of Gov. Flower, wrote me in reference to amending the county road law and the highway law, and pursuant to suggestions received and from others an act was drawn up putting town and county action upon the broadest possible basis, and the attempt was made to eliminate everything that would create opposition, but it was unfortunately lost through a survival of the opposition engendered in the Erie county contest. An attempt will again be made to pass it in some form.

"Another bill introduced by Mr. Kerr of Greene county provides for road building by local assessment and state and county aid, similar to the New Jersey law.

"There is another bill providing for the appointment of a county road engineer by each county. This bill seems to be too much in advance and impracticable, as it is doubtful if so many road engineers reside in the state.

"There is another bill introduced by Mr. Gray known as "The Forty Rod Bill," and which provides for state aid of a half up to $30,000 for each county in order to facilitate the building of object roads.

"There is also a wide-tire bill, prepared by Mr. Sweet, who is a specialist on the subject, and which has been introduced by Senator Mullin. As one of the supervisors of Monroe county suggested that the Reed bill of last year was objectionable in that it took away the rebate for wide tires from the highway tax, this bill provides a penalty for the use of the narrow tire after January, 1897, and offers a bounty for the change, of $8 the first year and $4 the succeeding year. If too complicated in its width provisions, I have written Senator Mullin to pass it in simpler form.

"The state road bill, laying out a thousand miles of road to be built by convict labor, has again been introduced into the legislature.

"This league has not presented any bill, and its point of view upon legislation, as in agitation, is to present the arguments and leave to the individuals freedom of action for or against. We may as well conclude that all legislation on this subject can not be radical, though it may be progressive, and I would submit to your consideration this: that, though the senate is composed of few and of men generally re-elected and experienced in legislation and the questions of public importance, the assembly is composed of a very large number, many of whom have had little previous experience, and that it will be necessary, in order to procure favorable legislation, to provide them with literature, as in their case as with the ordinary citizen, particularly of rural communities, there is needed very much more intelligent appreciation of this subject than now obtains; and with them, as with the others, it will be found that when so informed there will be a change of sentiment. I may add that I addressed an earnest letter to Governor Flower on January 4th upon the subject of state aid to the counties, in order to give the initial impetus in good road building, and I understand that he is not now opposed to such state action, if limited.

"I desire also to submit to your consideration the question whether this league should not advocate the establishment of a state commission similar to the Massachusetts commission. The subject I know is not free from difficulty and will undoubtedly bring upon ourselves the criticism of being seekers after state patronage, but from the man-

ner in which appointments are usually made, the chances that any member of the league will be appointed upon this commission are certainly meager, and if so appointed it would seem as if the same spirit which leads him now to do loyal service for the cause should impel like service for it under state direction.

"The impression has gone abroad that this league is advocating only new systems of roadmaking and stone roads. We must of necessity emphasize stone roads and a larger jurisdiction of those main market roads in which the community interest is dominant, and we do this believing when these are improved the improvement of the dirt roads will necessarily follow. The advocacy of these facts must of necessity come from the central organization, but in some form or other it should be manifested that even the most sanguine do not expect for many years that any more than the principal roads will be thus improved, and that the better care and maintenance of the ordinary dirt road is equally to be desired, but that this depends of necessity upon local effort, and the suggestion is made that in each locality members of the league see to it and instruct pathmasters in their improvement, and it is hoped to be able to furnish them with suggestions and literature upon this equally important side of the question."

RECOMMENDATIONS REGARDING PAVING IN TACOMA.

Conflicting petitions and remonstrances on the subject of street paving in Tacoma, Washington, have caused so much confusion that the chamber of commerce has undertaken to help the situation, and through a committee, composed of Charles E. Hale and R. A. Ketner, has offered recommendations substantially as follows: First, that the paving of Pacific avenue shall be begun without delay; second, that the paving shall be done with due regard for the utility of the street, to enable business to be conducted expeditiously and economically; third, that other streets shall be paved as soon as practicable. "As to the material to pave with," the committee says: "There are but two kinds now commanding the attention of municipal engineers, viz.: asphalt and brick. Granite blocks are used upon streets (in some of our large cities) that are subjected to extremely heavy and continuous wear. Outside of such streets granite blocks are not thought of. Your committee finds that brick are being largely used in the middle western states, and are well liked for their durability. Brick also has the advantage of being nearly noiseless. In the large and populous cities of the eastern and middle states asphalt is being almost universally adopted."

The committee also makes the rather remarkable recommendation that the contractors for paving shall be paid in warrants, without interest for two and a half years, and that they shall be required to pay their employes in cash at $1.50 a day. It can not be reasonably expected, of course, that a contractor can enter into an arrangement of this kind, if at all, without a very liberal charge to cover the unusual requirements which are proposed.

AN ADDRESS ON WELL PAVED STREETS.

An address was delivered at a conference on municipal government and improvements in New York on May 10, by Major J. W. Howard, on the subject of "Well

Paved Streets." It was arranged under distinct headings so that important and interesting points were clearly brought out. He opened with a demonstration of the importance of transportation and how vitally it is affected by pavements. A city to be successful must have good and sanitary pavements. The prosperity of a city in a large measure depends on its pavements. He briefly described sidewalks and how they are best constructed. Then, in referring to the general equipment of streets, he emphasized the importance of making provision for light, air, comfort and beauty, as well as more carefully arranging the electric light, lamp and other posts, also hydrants, letter-boxes, etc., which are now so often poorly placed, to the inconvenience of many. He cited the great progress made and showed the encouragement we can feel when we see the improved pavements of asphalt and granite now introduced in our cities. He praised the efforts made in this series of conferences which take up the city problems, among them the pavements which, when well laid and maintained, improve our surroundings, make life more healthful and profitable. Poor pavements injure business.

He clearly showed the need of obtaining full information by inspection and tabulated reports of the methods employed and splendid results accomplished in Paris, Berlin, London, Washington and other cities.

He demonstrated the value of trained men and retaining them in the employ of a city. These technical and trained men should be sustained in their efforts to provide for and compel good materials to be used, laid in the best manner.

Major Howard emphasized the necessity of tabulating all expenditures upon pavements, their maintenance and cleaning. These accumulated tabulations should be public property. There has been a tendency on the part of some officials in a few cities to regard a portion of their official experience as private, to the eventual injury of the city as well as themselves. Each succeeding official should have at his disposal in matters of paving and other technical work the accumulated experience tabulated by his predecessors.

He showed that the pavement of a street involves the city and its citizens in many expenses, directly and indirectly. The cost includes expenditures for pavements and their maintenance, street cleaning, cost of hauling heavy loads, vehicles, harness, sprinkling, the injury and expense due to mud, dust; in fine, he showed the intimate connection between the public and private purses and street pavements. Good pavements, well maintained, are true economy.

In defining a good pavement, among other things, he showed that it should not only provide for vehicles but be impermeable and not absorb, retain and give off disease germs. The dust of our houses is the dust of the street. He described briefly the manner of laying pavements and the materials used. He dwelt upon the necessity of concrete or other solid foundation for pavements. He enumerated first the poor materials then the good materials and how they are used, laid on proper foundations, as the wearing surfaces of pavements.

Paving blocks, he said, should be set with a more even general surface than we usually see them. The blocks in general use are too large. An informed public will demand good pavements.

The newspapers can do no more patriotic work than repeatedly inform the public what good pavements are and how constructed. The asphalt pavements are agreeable and have caused other kinds of pavements to be better laid or suffer by comparison.

He compared the grooved rail and pavement on Broadway in New York with the side-bearing rail on West street, showing how West street pavement has been almost ruined by that form of rail.

The co-operation of the different departments of a city produces good results. The pavements of New York are now being so laid with asphalt and granite that the city promises to become one of the best paved and cleanest great cities of the world.

AUSTRALIAN WOOD PAVEMENT.

An effort is being made by the United States Consul at Melbourne to secure for Seattle, Wash., the construction of one-half mile of Australian wood pavement. In Sydney this pavement costs from $5 to $6 a square yard, including the excavation of the streets. The life of the pavement is estimated at sixteen years. It is used in the busiest sections of the streets of Melbourne and Sydney, and after eight or ten years of wear it is found to have worn off about one-sixteenth of an inch. Consul-General Maratta says: "I have noticed in this city and Sydney where strips of the wood pavements have been joined to stone pavement, and where both have been subjected to the heaviest wear, that the wood pavement has worn even better than the stone, and where the two pavements join the edges of the wood blocks are not even chipped or worn."

The mayor of Seattle has received from Consul-General Maratta tracings of methods, reports of the city surveyor, estimates of cost and other valuable information relating to the pavement.

BRICK PAVEMENTS IN WHEELING.

In recent correspondence with the board of public works of Wheeling, W. Va., regarding the use of vitrified brick for street paving, City Comptroller Sturgeon, of St. Louis, Mo., was informed that a few of the streets in Wheeling had been paved with brick for ten years and are, apparently, good yet. The report says further that much depends upon the foundation used, the best in that city being concrete, which, completed, costs about $2.50 per square yard. Broken stone makes a good foundation, and costs about $2.00 per square yard. Part of the paving was laid on a gravel foundation, at a cost of $1.40 to $1.50 per square yard. If put down on a good foundation, the paving is expected to last fifteen or twenty years, and the street can be repaved on the same foundation at small cost.

DAMAGE TO KITTANNING POINT RESERVOIR.

The embankment of Kittanning Point reservoir, near Altoona, Pa., was seriously damaged by a flood on May 20. Mr. Harvey Linton, city engineer of Altoona, Pa., writes that the water flowed over the embankment, according to the evidence of eye witnesses, about thirty minutes, in which time there was a sudden rise of the water to a depth of one foot, for *less* than ten minutes, supposed to have been caused by the wind. The area of the water-shed of Kittanning Point reservoir is about nine square miles. The spill-way is about 5.3 feet in depth by 34 feet wide. The rainfall from Sat-

urday noon, the 19th inst., was 4.92 inches; 6.36 inches fell between Wednesday noon and Monday noon, 16th to 21st. The records of rainfall in Altoona have been kept for ten years by Charles B. Dudley, M. Am. Soc. C. E.

A NATIONAL SCHOOL OF ELECTRICITY.

A national school of electricity is about to be started in Chicago. It is an outgrowth of the World's Fair, and the president is Mr. J. P. Barrett, who was chief of the department of electricity at the World's Fair. The undertaking was suggested by the general demand for a course of lectures on practical electricity at the time of the World's Fair. The honorary faculty embraces the names of Edison, Tesla, Carhart, Gray and others of eminence in the electrical world. "The curriculum will embrace the foundation principles upon which the science of electricity is built, definitions of terms and phrases, and the construction and operation of all kinds of electrical apparatus. The lessons, prepared under the direction of the faculty, will embody a principle of teaching, specially adapted for the work contemplated, because of its simplicity. After thoroughly but briefly covering the first principles of the science, the lessons will proceed at once along practical lines to the construction and operation of the various classes of apparatus."

REPORTS OF MUNICIPAL OFFICERS.

Mr. F. M. Lillie, city engineer of Youngstown, Ohio, in his annual report mentions, as a new departure in Youngstown, brick paving on a foundation of Portland cement concrete with joints filled with Portland cement gravel. The results thus far have been very satisfactory. The cost is much less than that of the first brick pavements on a foundation of cinders. During the year 2,165 feet of brick sewers and 13,012 feet of pipe sewers were built in Youngstown.

Mr. George Platt, city engineer of Erie, Pa., reports that 47,262 square yards of vitrified brick paving have been laid there, all on a foundation of gravel, except 1,239 square yards, which is on a concrete base. Mr. Platt claims that the pavements with a gravel foundation look as well as those of other cities. He thinks that paving brick will soon be made in Erie. The city now has seventeen and a half miles of permanently paved streets, one-half of which is of asphalt and the remainder of brick and stone.

The annual report of Fred. H. Pickles, city engineer at Winona, Minn., for the year ending March 31, 1894, gives as the most important work performed during the year, the paving and curbing of the principal business streets of the city. The pavement was constructed last summer and consists of a single layer of brick laid edgewise on a well compacted foundation of sand and gravel. The curbing, of native limestone, is six inches thick. The total cost of the work is as follows: 24,118.9 lineal feet of 18-inch to 24-inch curbing, $12,783.02; 1,885.5 lineal feet of 16-inch curbing, $755.40; 368 lineal feet of reset curbing, $73.60; 72,874.7 square yards of paving, $104,939.57; total, $118,551.59. The brick used for this paving were required to stand the following tests: Absorption not to exceed two and one-half per cent.

their own weight; to contain not more than three per cent. of lime; the abrasion to equal the best quality of granite.

NEW ENGLAND WATER-WORKS ASSOCIATION.

The thirteenth annual convention of the New England Waterworks Association will be held at Boston, Mass., June 14, 15 and 16, 1894. During the three days session of the convention, the following papers will be read and discussed: "Laying a Sixteen-inch Main Across a Rocky Mill Stream and Over a Dam," by George F. Chace, Taunton, Mass.; "The Water Service and Fire Protection of Theaters," by William Paul Gerhard, New York City; "Experiments with Tube Wells at Lowell," by George Bowers, Lowell, Mass.; "Some Examples of Under-ground Water Supply," by J. J. R. Croes, New York City; "Electrolysis of Water Pipe," by C. A. Stone, Boston, Mass.; "The Lawrence Filter Bed and Its Results," by Hiram J. Mills; "Care of Water Meters," by J. C. Whitney, West Newton, Mass.; "What a Water Supply Engineer can do in the Fire Department," by James E. Tryon, Detroit, Mich.; "Latest Improvements in Pumping Machinery," by E. D. Leavitt, Cambridge, Mass.

MR. ROSEWATER'S OBJECTIONS TO MACADAM ROADS.

The plan of macadamizing the county roads of Douglas county, Neb., met with opposition from Andrew Rosewater, city engineer at Omaha, whose opinion, based as it is on sound judgment and a thorough understanding of the country and the nature of its soil, carries conviction with it. Before deciding upon the improvement, the county board of commissioners of Douglas county investigated macadam roads in Joplin and Kansas City, Mo., with, to them, gratifying results. But in Mr. Rosewater's opinion the difference in the soil of the three places will produce very different results. The soil of Joplin is gravelly and rocky, and Kansas City is built on a bed of limestone rock, while the soil of Douglas county is a retentive clay. In response to an inquiry recently regarding his views as to the paving of county roads, Mr. Rosewater said:

"I have my own peculiar views as to Douglas county. It is only fourteen miles wide from north to south, and about thirty miles east and west. I would have one great main road, as nearly straight as practicable, within certain limits of gradients. That road I would pave on a concrete base, and subdrain it to protect it against destructive action of frosts. Such a road would be ten miles shorter than the circuitous roads we have. Ten miles saved in distance is a saving of $150,000 in paving expense, and $150,000 saved in paving can grade 1,500,000 cubic yards. That much grading would give us good grades on a straight road and save ten miles in distance and the cost of ten miles of maintenance."

Mr. Rosewater says that if one main straight road were built instead of the three provided for, no part of the county would be more than seven miles from the thoroughfare, and this would enable the macadamizing of light traffic local roads throughout the county.

WIDE TIRES REQUIRED IN PITTSBURG.

An ordinance is being prepared for Allegheny and Pittsburg, Pa., requiring wide tires and no calks

on horseshoes. The ordinance will apply only to teamsters who belong to the cities and not to the farmers. The city of Allegheny will expend half a million dollars on its streets this summer and is, therefore, anxious to devise some means for their protection.

PAVING BLOCKS MADE OF HAY.

A novel paving block, made of hay, will be given a practical test by the Amies Pavement Company at Philadelphia, Pa., which will pave its yards with the material. Under heavy pressure the hay is pressed into cubes and then cut into paving blocks of convenient size; then it is soaked in oil, which renders the block indestructible, it is claimed.

LEGAL DECISIONS.

(Reported Specially for PAVING AND MUNICIPAL ENGINEERING.)

A Special Assessment for Street Sprinkling not Valid.—Sprinkling of streets is not a "local improvement" within the meaning of the statute authorizing cities and villages to make such improvements by special assessment. The decision of the city council that a proposed act constitutes a "local improvement" within the meaning of the statute is not conclusive. City of Chicago *v.* Balir (Supreme Court of Illinois), 36 N. E. Rep. 829.

Validity of Proceedings to Establish Highways.—Since public roads must not be less than 30 nor more than 60 feet wide, "to be determined by the county court" according to the utility and necessity of such road, the county court may establish a road 30 feet wide though the petition is for a road 60 feet wide, when it appears that such road is of public utility. The right of property-owners to a jury of twelve men in the county court on an issue as to damage caused by the establishment of a highway, is waived by an appeal by them from the judgment of such court on a verdict of six men to the circuit court, where they waive their right to a jury. Proceedings to establish a road on the county line and the corporate line of a town are not vitiated by the failure of the former owner of some of the land appropriated to release it, when he has conveyed it to the town for a road and expresses a willingness to relinquish it for the purposes of the road. In re Essex Ave. (Supreme Court of Missouri, Division No. 2), 25 S. W. Rep. 891.

Validity of Municipal Bonds.—Where bonds are issued under Gen. St. Kan., 1889, which declares that cities may "borrow money and issue bonds therefor" whenever "the city council shall be instructed so to do" by vote of the inhabitants, it is no objection to the validity of such bonds that the council submitted the matter to the electors by means of a resolution rather than ordinance, where there is nothing in the statutes expressly requiring an ordinance in such case. The law is well settled that a municipal corporation may declare its will within the scope of its corporate powers, either by a resolution or an ordinance, unless its charter requires it to act by ordinance; and generally it is of little significance whether a legislative measure is couched in the language of an ordinance or of a resolution, where it is enacted with the same formalities which usually attend the adoption of ordinances. If the action taken by a municipality amounts to prescribing a permanent rule of conduct, which is to be thereafter observed by the inhabitants of the

municipality, or by its officers in the transaction of the corporate business, then, no doubt, the rule prescribed may be more properly expressed in the form of an ordinance; but it is eminently proper to act by resolution if the action taken is merely declaratory of the will of the corporation in a given matter, and is in the nature of a ministerial act. City of Alma *v.* Guaranty Saving Bank (Circuit Court of Appeals, Eighth Circuit), 60 Fed. Rep. 202.

Liability of Electric Light Companies.—It is due to the citizens that electric companies that are permitted to use, for their own purposes, the streets of a city or town, shall be required to exercise the utmost degree of care in the construction, inspection, and repair of their wires and poles, to the end that travelers along the highway may not be injured by their appliances. The danger is great, and care and watchfulness must be commensurate to it. Haynes *v.* Raleigh Gas Co. (Supreme Court of North Carolina), 19 S. E. Rep. 345.

Assessment of Benefits for Public Improvements.—In an action against an abutting owner to recover benefits for grading a street, the affidavit of defense is sufficient where it alleges that the grading "was not done according to the grade established by ordinance, but according to another grade, established by the city engineer without authority." Act 1874 conferred on cities power to improve streets, charging the costs to abutting lots according to frontage if in the urban portion of the city, and the city at large if in the rural portion. Act 1889 authorized the assessment of costs, "in case of grading only" on the properties benefited, according to benefits. Abutting lots in the urban portion of a city may be assessed according to benefits or according to frontage, and in the rural portion according to benefits only. City of Scranton *v.* Bush (Supreme Court of Pennsylvania), 28 At. Rep. 926.

Liability to Abutting Owners for Improvement of Streets.—In the control and improvement of its public streets a municipal corporation, in the absence of any lawful restriction or regulation to the contrary, has the same rights and powers as a private owner has over his own land, and, as to abutting owners, is subject to the same liabilities. Munger *v.* City of St. Paul (Supreme Court of Minnesota), 58 N. W. Rep. 601.

PERSONALS.

Mr. W. Wayne Robinson has been made city clerk, at Lambertville, N. J., to succeed W. H. Wilmot.

J. Tudor Graves, city engineer at Fargo, N. D., has returned from England, where he spent the past winter.

Mr. Daniel W. Mead, Rockford, Ill., has been engaged to make surveys for the water-works system at Dundee, Ill.

Chester B. Davis, C. E., of Chicago, Ill., prepared the plans and specifications for the water-works system at Danville, Ky.

Potter & Folwell, of Pittsburg, Pa., have been engaged to make surveys and designs for a system of sewers for Pittston, Pa.

Mr. Frank B. Rae, Detroit, Mich., has been engaged as electrical expert by the city of Hamilton, Ont., for the proposed municipal electric plant.

Mr. James T. McAndrews was recently appointed superintendent of sewers, at Chicago, Ill., by Mayor Hopkins, to succeed the late O. H. Cheney.

Messrs. James T. Sugden, George McClumpha, David Mathias and Henry Becker have been appointed sewer commissioners, at Amsterdam, N. Y.

At the last meeting of the Western Society of Engineers held on May 2, Mr. Thomas Appleton tendered his resignation as librarian of the society, and Mr. Charles J. Roney was elected to fill the vacancy.

Mr. John P. Moore was elected mayor of Snow Hill, Md., May 8, with the following as members of council: Dr. Erastus S. Dashiel, Dr. Paul Jones, Robert J. McAllen, Robert W. Townsend and John J. Collins.

The new board of public works, at Kansas City, Mo., is composed of Peter H. Tiernan, president, John C. Gage, Luther C. Slavens and Linn K. Thatcher. The board will serve as water commissioners, also. Mr. W. L. Cameron has been made superintendent of the water-works.

At the spring election in Syracuse, N. Y., Hon. Jacob Amos was re-elected mayor, Henry C. Allen was reappointed city engineer and Hector B. Johnson, commissioner of public works. Samuel M. Gray, of Providence, R. I., was appointed consulting engineer in the matter of sewerage extension and revision.

LETTERS FOR THE PUBLIC.

THE SOLVENT ACTION OF ETHYLIC ALCOHOL ON ASPHALTS.

To the Editor of Paving and Municipal Engineering:

In order to discover different results, if there are any, and also to find out the cause, I made several trials with refined Lake Trinidad asphalt and refined Bermudez asphalt. The collected samples were of different ages and different cargoes. They were separately submitted to the solvent action of alcohol, at ordinary temperature, and the results noted were variable, as seen below.

I remarked in most all the filtrates, insoluble bitumen, which was removed by filtering until perfectly clear and transparent.

Refined Bermudez Asphalts.

No. 1,	soluble	in	alcohol,	1.40	per ct.
No. 2,	"	"	"	4.03	"
No. 3,	"	"	"	18.00	"
No. 4,	"	"	"	19.10	"
No. 5,	"	"	"	20.70	"

Refined Lake Trinidad.

No. 1,	soluble	in	alcohol,	3.25	per ct.
No. 2,	"	"	"	5.00	"
No. 3,	"	"	"	7.50	"
No. 4,	"	"	"	17.75	"
No. 5,	"	"	"	21.00	"

Dr. Keyser, who has made many important investigations on Trinidad refined lake asphalt, found in it from four to five per cent. to be soluble in alcohol.

Samples of the same asphalts not having been treated with alcohol were separately submitted to the solvent action of ether, and it is observed that those yielding small percentage of soluble bitumen in

alcohol yielded almost the same percentage of petrolene as the high graded.

We show by the foregoing tests that some refined asphalts, although from the same source, are differently affected by alcohol with different results. Consequently by the quantity of bitumen soluble in alcohol we can not judge of the quality of an asphalt. It becomes necessary to submit this soluble bitumen to different tests by which it becomes possible to give a clearer judgment.

In many asphalts are found an objectionable, resinous compound soluble in alcohol and also in caustic soda or potash. Thus it becomes necessary to find out if the bitumen soluble in alcohol is also soluble in caustic potash or soda, and if so in what quantity. So I made separate tests with the soluble bitumen in alcohol, of both asphalts, and only small percentages were found to be soluble in caustic soda or potash.

Other asphalts were submitted to the same process and in two of them I found large percentages of this objectionable, resinous matter.

If we inquire for the causes of the discrepancy of the solubility in alcohol of certain asphalts, at present I can only offer the following propositions: It may be reasonable to think that a small quantity of a saturated or unsaturated hydrocarbon, having the property of giving to alcohol a powerful solvent action, has been modified or evaporated during the refining, or otherwise. This could explain and answer our question, but more investigations are required in order to arrive at a more positive conclusion, to which I am now devoting some time.

I feel thankful to Captain Torrey for his kind feeling toward me. I never thought he would willingly construe in a controversy like this personal contradictions, but it seems that Captain Torrey is ignorant of certain facts, and consequently he makes blunt statements, of which he does not realize the importance of misleading our reading public.

My answer to Captain Torrey's comments has been delayed by sickness, but shall be offered for publication in the next issue of PAVING AND MUNICIPAL ENGINEERING. *E. J. De Smedt, Chemist.*

ECONOMIES OF WIDE-WHEEL TIRES.

To the Editor of Paving and Municipal Engineering:

PAVING AND MUNICIPAL ENGINEERING for April refers to Mr. Julius H. Striedinger's and Mr. Von Geldern's report on "Country Road Construction," and quotes among other things, "It is proper here to remark that in more recent times the views as to the utility of very broad tires have somewhat changed, it being generally admitted nowadays that outside of a certain tire-width a uniform transmission of pressure does not take place." This, taken in connection with what immediately follows, seems to me to indicate that Mr. Striedinger endorses the "recommendation of 4¾ inches as the maximum tire-width." It is of course true that beyond a certain tire-width per ton of total load, which proper width per ton becomes somewhat less as loads increase, there is no gain from increase of width of wheels. But that 4¾ inches can be any thing but a special limit for a given combination of maximum loads with material and crowning of surface, it is simply unreasonable to admit.

Unfortunately, I have not been

able to get hold of the report of the French commission or any of the details of that report. The results are reported often enough, but who knows what these results mean in the absence of conditions and details. Mr. Striedinger would confer a great favor by furnishing some proof that 4¾ inches may be accepted as a sufficient width for any load on earth, or on gravel, or on macadam, or on brick, or on asphalt, of any permissible flatness of surface. It may be freely admitted that 4¾ inches is as good as any other width on granite block or any stone block pavement, especially in view of the great expense for springs entailed by such pavements, but this fact is only another reason why stone block must not be used if we are to have not only the greatest economy of surface but the greatest economy of traffic which cost includes the cost of surface as a smaller item. Morin gives "15 lbs. per ton as the pull on asphalt and 33 at a walk; 66 at a trot on granite block." The difference in use-cost or cost of wearing the two, is then 18 to 51 lbs. according to speed; or say 30 lbs. average. If now the cost of wearing asphalt is as great per yard per year as the average cost of the pavement per yard per year, granite in Memphis would cost in 30 years $4.90 per yard more than asphalt, and granite block anywhere would entail a wearing cost about $24 greater per yard. This is taking asphalt at $2.50, plus 10 cents guaranteed maintenance for the first five years; plus 15 cents guaranteed maintenance for the second five years; plus 25 cents guaranteed maintenance for the third five years; plus $1.50 for relaying at fifteen years; plus 50 cents for maintenance guaranty as above, fifteen years; plus compound interest at 6% from time of expenditure of each to end of thirty years.

These figures are modified for the case of the use of proper wheels. Granite in Memphis equals $4.35 average, assumed life thirty years, no cost of repairs added, compound interest at six per cent. for thirty years computed. Excess of granite over asphalt, $4.90. But this is comparatively unimportant if it is admitted that it costs as much to wear out asphalt as to put it up and keep it up, or, say about one cent per pound of pull per ton per yard per year. For the 30 cents difference per yard per year, at compound interest at six per cent., equals $23.85 in thirty years. Total difference equals $28.75. In sixty years this becomes $196. Now the difference of 18 to 51 pounds between the pulls per ton on granite and asphalt, is not unreasonable, while the 4¾-inch limit is obviously incorrect as a general rule.

Of course, the average speed may not give 30 pounds as an average, and 30 pounds may not mean 30 cents per yard per year, but it may mean much more, since the 15 pounds pull on asphalt may mean more than 15 cents per yard per year, as cost of horses, vehicles, etc., for an equal cost of pavement. It is doubtless known that we lose the compound interest on the difference in cost as well as the difference itself. Nor will it be said that six per cent. compound interest on the difference is as good a thing as we could get by putting the difference—say $4.35 minus $2.75, add the 30 cents per yard per year—into more asphalt. Now, it is not impossible that either brick or macadam topped with crushed granite might be cheaper than asphalt, *supposing the best width of wheel to be used in every case.*

J. M. Heiskell.

AN INQUIRY REGARDING THE SUPPLY OF ASPHALT.

To the Editor of Paving and Municipal Engineering:

For the past fifteen months I have been carefully reading your magazine and all books, pamphlets and reports that had any reference to the subject of asphalt and all bituminous products, and I find that I have yet much to learn in order to reconcile the glaring discrepancies to be found in the statements and assertions of those who are interested or prejudiced in favor of competing products.

I have carefully read the reports of Professor Clifford Richardson, of Washington, and Engineer Towle, of New York, men eminent in their professions, and who, in the interest of science and for the good of mankind, visited the Island of Trinidad at their own expense in order that they might study that one branch of the asphalt question to the best advantage. They saw, analyzed, studied and were conquered.

I read of what they saw, analyzed and studied, and was conquered, and felt that their conclusions were incontrovertible, and the mental peace that comes from settled convictions took possession of me. But my happiness was only to be transitory, for a fiend in the guise of a friend sent me a copy of Consular Report, No. 145. After reading and studying it, chaos again reigned in my brain on some points of the Trinidad asphalt question. So now, as a dernier resort, I appeal to the readers of, and contributors to, your magazine for enlightenment on only one point at this time. So I submit the following queries:

Is the asphalt taken from the pitch lake on the Island of Trinidad imported and controlled by a monopoly?

Or is it a merchantable commodity in every sense of the term, so that any person who may desire to engage in the paving business could buy it at such a price that he could compete on an equality with the importers, if they were engaged directly or indirectly in the paving business?

Is the so-called Pitch lake leased or controlled by any company that is interested in paving, either directly or through owning stock in any company or companies engaged in the asphalt paving business?

What are the names of the companies connected with the importers?

There seems to me to be a conflict of testimony on this particular point between the United States consul on the Island of Trinidad and Messrs. Richardson and Towle. And as the question of competition in paving is being generally agitated, the opening up of the question in your valuable magazine may be productive of much good and enlighten us benighted students of the great asphalt question. But it seems to me that it is not hoped or expected that a public official charged with an important public trust should dare to have any opinions of his own, but should take all unsupported assertions of professors and engineers as final.

Not having a plastic mind or elastic conscience, I must seek for proofs, especially when eminent authorities disagree; and I have no doubt but that the importers and the paving companies who use the Pitch lake product will welcome the discussion.

Arthur C. Harris,
Pres. Board of Public Works.
Denver, Colo., May 18.

[We can not authoritatively answer the questions of Mr. Harris, but we are informed by one of the Trinidad asphalt paving companies

that any one can purchase Trinidad asphalt on the same terms that it is bought by the companies now most largely using it. In support of this statement it is cited that within the last few days five firms submitted bids on a proposed contract in Milwaukee requiring the use of Trinidad asphalt from Pitch lake. Among these were two local contractors. The inquiries of Mr. Harris, however, may be better answered by those who are in a position to speak authoritatively.]

AN EXPERIMENT IN PAVING AT TACOMA.

To the Editor of Paving and Municipal Engineering:

The city of Tacoma, six months ago, completed a section of street paving which may be of interest to your readers. The street paved was Pacific avenue, which carries a heavy traffic, owing to the location of wharves at one end, the railroad freight sheds and manufacturing district at the other, with the passenger depot and wholesale houses midway between the extremes. In addition there are two lines of electric railway and the usual number of teams found on the main street of a live, active city. The street has a comparatively regular grade running along the foot of a hill that rises some three hundred feet in thirty-five hundred. It therefore catches all the seepage of this hillside, and as a part of the street was originally the worst sort of swamp land overlying a stiff blue clay formation filled with live quick-sand, springs and old brick-yard wells, it can readily be seen that the problem of making a permanent roadway was a serious question. When the lower end of the street was first opened, some four years ago, in order to make it passable it was covered with 4x12 plank, up through the cracks of which soft muck was constantly oozing. In tearing up the car tracks, we found places where five layers of 4x12 plank had been placed as stringers under the ties to keep the track out of the mud.

At the time when this company first advocated the paving of the street with bituminous rock on a six-inch concrete foundation, the idea was scoffed at, some going so far as to declare that the pavement would go to pieces in one week's time, but after two years' agitation we succeeded in securing a contract to pave the worst portion.

City Engineer Morrison's plans and specifications, the latter being particularly complete and comprehensive, were faithfully carried out. To-day, after six months of wear through the rainy season, the street does not show a sign of weakness at any point, although daily there are loads of six tons and upwards passing over the street. Horses obtain a sure foothold through various kinds of weather —rain, sleet or snow—not a single fall having been observed since the time it was opened to travel.

The pavement consists essentially of two inches of bituminous lime rock, laid upon a six-inch concrete foundation. Great care was taken in the sub-foundation, gravel and broken stone being liberally used. The sub-waters are taken care of, and the question of car-track construction is also solved in a way to make the tracks and repairs on the same independent of the pavement. The surface drainage from the hill streets, which, owing to the annual rainfall of some seventy inches here, is large, all pours down through open gutters to the avenue, where it enters catch-basins on the upper sides of the street through the openings in the curbs at the intersecting street corners.

From these catch-basins the water is carried under the street through twenty-four-inch sewer drains to tide water. All seepage from the car tracks and any sub-drainage of the street is also carried through four-inch tile drains into these catch-basins. Over the gutters at street crossings are placed aprons so that an abrupt step is avoided and the foot passenger can travel dry shod over the gutters. The roadway rises on the arc of a circle to a height of eleven inches above the gutters, and presents an attractive appearace. *E. W. Gilmore.*

Tacoma, Wash.

MUNICIPAL ELECTRIC LIGHT PLANTS.

At the regular meeting of the Civil Engineers' Society of St. Paul, on May 7th, the paper of the evening was by Mr. O. Claussen, on the "Requirements of a Municipal Electric Light Plant Installation." He advocated the location of the power house near a plentiful supply of water, that compound condensing engines might be used, yet far enough from the business center to escape excessive cost of real estate and near enough to profit by transportation facilities and to minimize length of pole lines. Tiled floors for engine and dynamo rooms were suggested, rubber mats to be placed where necessary for protective insulation. A traveling crane as a fixture would assist in handling the equipment. Machinery foundations should be massive, and built of hard burned brick laid in Portland cement. He favored low speed, triple expansion engines, water tube boilers, extra feed pump capacity, economizers and smoke consumers. Steam pipes should be furnished with magnesia casing and fitted with numerous valves in case of accidents. For arc lighting the general practice seems to demand shafting and belt connections, while direct connection between engine and dynamo is common for incandescent lighting. The direct constant current arc light machine is now constructed to operate in safe practice one hundred 2,000 candle power lamps with a voltage of 5,000 and a current of 10 amperes. In the vicinity of St. Paul, with a first class plant, a system of 1,000 lamps should be operated all night and every night at a total cost of $90 per lamp per annum.

C. L. Annan, Sec'y.

SELECTIONS FROM THE PRESS.

BRICK PAVING TO T RAIL.

The question as to whether it is practicable to pave to the T rail, has apparently ceased to be a question in many towns, especially in Illinois and Iowa. Where brick paving is coming extensively into use, the T rail is almost sure to come also, and in places where it is used the question seems never to be raised as to whether paving to them is a success or not. It seems to be taken as a matter of course. Among the many places that sanction the use of T rail, are Bloomington, Ill., Decatur, Ill., Ft. Wayne, Ind., Champaign, Ill., Springfield, Mass., Ottumwa, Iowa, Des Moines, Iowa, Terre Haute, Ind., Atlanta, Ga., Windsor, Ont., Roanoke, Va., and Denver, Col. In some of these places the road is principally girder

rail, and the city has changed its rules to allow the laying of T rail in the future. Where it has been laid there is no smooth iron tram for vehicles, and consequently there is not so much tendency to drive on or near the tracks, and the wear on the company's pavement is correspondingly light. Teamsters, city officers and transfer companies claim that as far as the street traffic goes, it is a less obstruction than the girder or tram rail, and a few minutes observation of the vehicle traffic on such streets bears out this statement. The main objection to the T rail for street tracks is that the groove between the rail and paving sometimes fills up with dust and ice so as to greatly hinder the car traffic, but by the use of sweepers in summer and salt in winter this is to a great extent prevented. A special form of brick for paving to T rail is made. In some places the ordinary brick are used and the workmen chip out pieces to make the groove for the flange and accommodate the head and base of the rail. The greater part of the brick paving in use at present is on a foundation of soft brick laid flatwise. If no chairs are used, and the rail is four inches high, the space between the ties is filled in with foundation brick laid even with the top of the ties, and the paving brick laid directly on these. In this case it is necessary to tamp very hard where the foundation brick are laid between the ties, as the ties make an absolutely rigid foundation, and the paving between the ties is liable to settle. At Decatur, Ill., a cast iron block is used. It is the design of Superintendent Ferguson, and is simply a cast iron slab, flat on the bottom and paneled or hollowed on top to save iron. It is, of course, laid with its longest dimension at right angles to the rail and the notches are for the spike holes. This raises the rail about three-quarters of an inch from the tie, and gives room for a layer of sand between the foundation of brick and ties and the paving brick proper. The secret of the success of brick paving for use with T rail, is the fact that it furnishes a smooth surface with close joints, and the brick can be molded or chipped to any shape so as to make a good fit, not only with the main part of the rail, but at the joints and fishplates. A great many companies are in the habit of making their own T rail curves, the guard rail being made of a lighter section of T rail placed on blocks or chairs. This is claimed to be a cheap and durable construction, as the curves will wear as long as the head of the guard rail will last, which is, of course, a good while. In many instances the guard rail is put only on the inside. When the paving is down, these rails have the appearance of being one piece with the track rail.—*Street Railway Review.*

TO TEST THE AIR OF MAN-HOLES.

Many serious explosions have been imputed to the ignition of an electric spark in man-holes into which gas has leaked. It is proposed to reduce the risk of such accidents by constructing an instrument by which the percentage of hydrogen present in the man-hole can easily be measured without lifting the cover. Fire-damp and gas indicators have been made by taking advantage of the high rate of diffusion of light gases through porous partitions, and a thin tube of unglazed earthenware might be mounted at the end of a staff, and be connected with a gauge, the readings being indicated on a dial by means of an aneroid movement or by mercury in a thermometer

tube. This instrument could be graduated to show the percentages and the limits of explosive mixtures. The adjustment of temperature errors could be made by using two similar tubes, one being rendered non-porous. The tubes would be connected by a glass thermometer tube, and the displacement of a mercury index would measure the amount of hydrogen. A one-inch hole in the man-hole cover, closed by a lock-flap or a screw-puge, would suffice for the test.—*Iron Age*.

A BOSTON TRIBUTE TO BRICK PAVEMENTS.

The advantages of brick pavements are numerous. From the reports of city engineers, wherever paving brick are used the cost is shown to be less per square yard than stone, asphalt or macadam. Their durability is such that at Galesburg, Ill., no wear on the bricks is perceptible in a pavement which has had heavy travel on it for ten years. Similar reports come from all cities where bricks have been used for a number of years. Brick pavements produce neither mud nor dust. From personal experience the writer can say that a well laid brick pavement is nearly as smooth to drive over as asphalt. Almost no noise is made on it by the heaviest teams. By virtue of the numerous minute rough surfaces on the bricks, they afford safe footing for horses in all weathers. The life of brick pavements can not be estimated, for in almost no case where they have been laid have they been subject to repairs.

It may thus be seen that brick pavements have all the desirable qualities which exist in the other kinds with none of their objectionable features. Fitted equally for the business of city streets, for the boulevards or for the roads leading far out into the country, for the passage of heavy drays, for carriages, or for swift bicycles, brick pavements commend themselves to all classes of people. The cities of the west, progressive in everything, have in the matter of brick pavements set an example which we should certainly imitate. It is to be hoped that the men who have in charge the improvement of our roads will make trial of brick for paving, and thus add to the safety, comfort and convenience of man and beast.—*Boston Transcript*.

MACHINERY AND TRADE.

HOW THE WORLD'S FAIR ROADWAYS WERE MADE.

The O. S. Kelly Co., of Springfield, O., has issued a brochure, descriptive of roadmaking by the Springfield Steam Rollers. It is entitled, "Prize Winners at the World's Fair," and is made exceptionally valuable and attractive by a reproduction in miniature of colored illustrations of prize paintings exhibited at the World's Fair, printed on heavy enameled paper, including, "Reading Homer," and "Fireside Fancies," by Laurens Alma Tadema, "The Ornithologist," by Millet, and "The Yarn," by John R. Reid. The publication is also beautifully illustrated with picturesque views in which the Kelly Steam Road Roller is shown. A description is given of the making of fifty miles of roadway in the World's Fair grounds. "As re-

gards the material," the description says, "by far the greater portion of the work was composed of gravel, a small portion of broken stone of uniform size and hardness and a still smaller portion of broken stone and gravel mixed. The ground upon which these roadways were built was nothing but sandy waste or bog, entirely destitute of grass and impassable to the lightest traffic." The result was mainly due to the use of six Springfield Steam Road Rollers, manufactured by the O. S. Kelly Co., Springfield, O., which first rolled the sand foundation so as to enable the gravel to be put on to the proper thickness and shape, which in its turn was rolled and re-rolled until the required hardness and smoothness was attained, the heavy rollers being very effective and compacting the loose material rapidly.

"A strong contrast can be imagined by picturing the ordinary method of road making, which is to gravel to a depth of 12 or 14 inches, leaving it loose, to be compacted by passing traffic, so that instead of having a hard, smooth surface, such as would be produced by the use of heavy steam rollers, there is a foot or so of loose gravel. If such contrasts between the rolled and un-rolled roads can be attained so quickly and effectively, the question arises, why are not steam road rollers used on pikes or country roads? They can and should be used on every road that is made, and should be used not only on top surface but first of all on the bottom or sub-grade as it is called. This sub-grade should be leveled off and shaped to the desired grading of the finished surface. Then, before new material is put on it, the steam road-roller should be passed backwards and forwards, and it will then be seen that what before was level is full of hollows and ridges, showing that the natural earth was not of uniform hardness, the softest places sinking beneath the roller and producing the hollows. These hollows must be filled up and the roller worked over the hard sub-grade again, making it uniform and hard. The hard or consolidated sub-grade is now ready to receive the material which is to compose the wearing surface of the road, and which should be put on in layers of say 4 inches thick and the roller be used freely on each layer. In this way much better results can be obtained than if the roller is put on a single layer of 8 or 12 inches thickness." [The O. S. Kelly Co., Springfield, O.]

CHAMPION ROAD MACHINERY.

The American Road Machine Company has issued new catalogues describing their road-making machinery, including wheel scrapers, road rollers, rock crushers, drag scrapers and road plows. Much space is devoted particularly to the Champion Steel Rock Crusher, for which special merit is claimed because it is light in weight, simple and durable in construction and portable, the latter making it "conveniently useful for towns and townships where the stone to be used is not all in one place." The power is exerted through the rolling action of a double cam shaft. The main shaft is elliptical in shape, and one revolution of the fly wheels produces two movements of the jaw. This reduces the amount of friction one-half, and consequently secures a great saving in power and less wear of working parts.

The fly wheels perform a very important part, as they serve the triple purpose of balance wheels, belt wheels and of traveling wheels when the machine is in motion on

the road. Every machine is supplied with two wheels, each weighing 800 pounds on the No. 3 crusher, and 1,000 pounds on the No. 4. A wooden pulley or belt wheel is supplied with each crusher, which can be attached to either fly wheel. This wooden belt wheel is usually forty-four inches in diameter for the No. 3 crusher and fifty inches in diameter for the No. 4, and is furnished because, as the regular fly wheels serve the purpose of rear traveling wheels for the crusher, they will become too much roughened for belt wheels.

The size of the product is regulated by toggles of different sizes, four of which are supplied with each machine. These toggles are a special casting, with a chilled surface. The four toggles admit of a range of work from three-fourths of an inch to two and one-half inches, all that will ordinarily be required. The change of toggles can be effected in a few minutes.

It is estimated that from seven to thirteen tons of rock can be crushed hourly on the No. 3, and from twelve to eighteen tons on the No. 4. [American Road Machine Co., Kennet Square, Pa., or J. D. Adams & Co., Indianapolis.]

PAVING BRICK IN THE SOUTH.

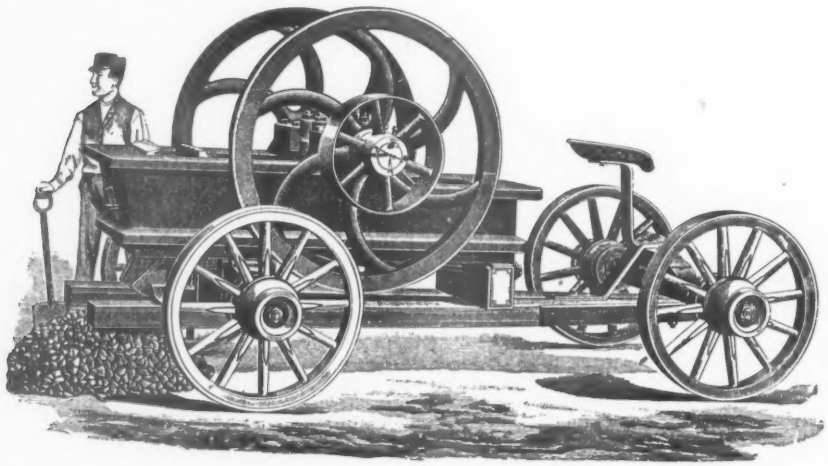
John W. Sibley, treasurer of the Coaldale Brick and Tile Manufacturing Company, of Coaldale, Ala., in an interview published recently in the Montgomery, Ala., *Advertiser*, said of the paving brick which is now being manufactured in Alabama: "We subjected a sample of our vitrified brick, taken at random from the kiln to the following severe test: It was placed under a steel drill, tempered enough to bore through a solid bar of steel. It made the slightest impression upon the face of the brick, and the resistance was so great that the drill was burning away. Without retempering, this drill bored through a two-and-a-half-inch hard burned common brick. A fourteen-inch saw file was worn out in trying to make an impression upon the face of the vitrified brick. These facts are proofs of the hardness and durability of our paving brick. Samples of these brick are now on exhibition at the city engineer's office and I would be glad to have property-holders call and inspect same. Tested at the Pittsburgh Laboratory these brick withstood a pressure of 220,000 pounds to each brick. This is equal to the largest weight of the locomotive that runs into Montgomery piled in a vertical column on one brick. This should be sufficient to convince the most skeptical. When brick are properly manufactured and thoroughly vitrified in burning, there is no way of calculating the life of a brick pavement, as there seems to be nothing that can wear it. In vitrified brick the civil engineer will find just what he is looking for."

MUNICIPAL MACHINERY.

The F. C. Austin Manufacturing Co., of Chicago, has issued a new catalogue, "covering the latest improvements in labor-saving appliances for constructing, grading and cleaning natural and paved roads and streets." It is very complete. It treats of the New Era wagon loading, ditching and railroad grading machine, dump wagon and garbage cart, reversible road roller, rock crusher, steel street sweeper, street sprinkler, steel reversible road machine, steel tubular truss bridges, wheel and drag scrapers, railroad and township plows and earth handling tools of all kinds. The machinery is all fully described and illustrated, and its advantages shown, in connection with which

many helpful suggestions are made.

The new rock crusher manufactured by this firm has a distinct feature in the arrangement of the pivotal point of the movable jaw. The movable jaw has no rigidly pivoted point, but is provided at its lower end with journals that move lengthwise in slots, thus permitting the lower half of the jaw to have a corresponding alternating motion with the upper half. This enables the crusher to crush



continuously, both on the advance and receding motions of the jaw. The jaw being loosely pivoted at the lower end gives a wide range of motion at the upper part of the jaw, and when stone is introduced the jaw coming against it two hundred and fifty strokes a minute with a wide range of motion comes with great compressive and striking force, crushes the stone rapidly and gets it out of the way. There is no tendency to clog, and the capacity of the machine is greatly increased.

Every strain to which the crusher can be subjected has been accurately calculated and the amount of metal used in the various parts nicely proportioned, so that it is claimed for it that it is really stronger than necessary. The construction is simple as well as durable. The machine has neither cog nor sprocket wheel, clutch nor pinion. Every bearing is open to view, easy of access and provided with oilers. The frame is one solid piece of iron, heavily flanged. On the smallest sized machine this frame weighs over 4,000 pounds. [F. C. Austin Mfg. Co., Carpenter St. and Carroll Ave., Chicago.]

ABSORPTION TEST OF PAVING BRICK.

In a recent test of absorption at Evansville, Ind., the Clinton paving brick stood first, showing a gain of only 20-100 of an ounce.

IMPROVEMENT AND CONTRACTING NEWS

PAVING.

The Green street paving at Urbana, Ill., is progressing rapidly.

The Church street paving at Champaign, Ill., will begin about July 1. The Sheldon Brick Company has the contract.

O. R. Rauchfuss, city engineer at Joliet, Ill., writes that Campbell & Dennis began paving Centre street May 17. Galesburg brick will be used.

The cement sidewalks being constructed by the Vulcanite Paving Company, in all parts of the city of Philadelphia, are reported to be eminently satisfactory in every respect.

Asphalt, granite and Belgian blocks are favored for street paving purposes, by Mayor Schieren, of Brooklyn, N. Y., who also thinks that the law in that city should be so amended that it will prevent further use of cobblestones.

CONTEMPLATED WORK.

Street paving has been proposed at Tomah, Wis.

Marion, O., will issue $100,000 bonds for street paving.

The paving question is being considered at Oskaloosa, Ia.

West State street, in Trenton, N. J., will be paved with Belgian blocks.

The question of paving Main street, at Merrill, Wis., is being agitated.

The paving question is being considered at Antigo and Rhinelander, Wis.

The question of paving Main street, Charles City, Ia., is being discussed.

The paving of several blocks of the avenue is being agitated at Marshfield, Wis.

The question of paving Main street is again being agitated at Salamanca, N. Y.

An asphaltic pavement will probably be constructed on North Broadway, St. Louis, Mo.

About a mile of Main street will be paved with brick at Ottumwa, Ia., this summer.

An asphaltic pavement for Lower Fifteenth street has been petitioned at Denver, Colo.

Ordinances have been passed at Toledo, O., for paving Oak street and Euclid avenue this season.

The city council at Kenton, O., has declared it necessary to macadamize part of South High street.

An asphaltic pavement has been asked for by the property-owners on Eighth and Cherry streets, Erie, Pa.

An asphaltic pavement has been petitioned by the property-owners along Mulberry street, Scranton, Pa.

It has been proposed that St. George street, from King street to the Gates, at St. Augustine, Fla., be paved.

The property-owners in the Sixth and Ninth wards, at Covington, Ky., recently signed a petition favoring brick paving.

F. L. Niederheiser, city civil engineer at Ashland, O., writes that two streets will be paved this summer, and probably three.

A bill has been introduced in the legislature, at Columbus, O., to expend $6,000 in improving the Columbus and Delaware pike.

Legislation has begun at Poughkeepsie, N. Y., asking for an asphalt block pavement in Market street, from Main to Montgomery.

The city council at Lima, O., has passed a resolution which provides for paving the public square with hard-burned blocks or paving brick.

The city council, at Trenton, Mo., recently passed a resolution authorizing that College avenue be macadamized, guttered and curbed.

A recent election at Ludwick, Pa., on the question of paving the principal street with vitrified brick, resulted favorably for the proposed work.

The construction of a cedar block pavement in several streets has been determined upon by the common council at Stevens Point, Wis.

The board of street and sewer directors, at Wilmington, Del., has been petitioned to pave West street, between Eighteenth and Nineteenth streets.

J. Tudor Graves, city engineer at Fargo, N. D., writes that the city is talking of paving some of the main streets, but no definite action has yet been taken.

The city of Los Angeles, Cal., is making a move to construct a grand drive or boulevard between that city and Pasadena. It will be about nine miles long.

The board of public works, at Grand Rapids, Mich., has decided to pave a portion of La Grave street with Trinidad asphalt. Estimated cost, $450,000.

Fifth avenue, from First to Sixth streets, Mount Vernon, N. Y., will have an asphaltic pavement, at an estimated cost of $40,000. Plans have been ordered prepared.

Mayor Schoch, Ottawa, Ill., who wanted South Ottawa hill paved last year, has again recommended it in his message to the council, and it will probably be done this year.

The board of town officers and highway commissioners of North Hempstead, N. Y., are taking action towards the purchase of a stone crusher, and possibly a road engine and truck.

It has been proposed at Marinette, Wis., that the city pave from one to one and a half miles of streets each year, and connecting always with pavements that are constructed.

Property-owners in Omaha, Neb., have petitioned for paving six districts, and it is thought that the city council and board of public works will not delay the letting of contracts long.

An ordinance was passed May 1 at Sandusky, O., providing that bonds be issued in the sum of $15,000 to pay for the proposed paving of Market street, from Wayne to Warren streets.

The council committee on highways, at Baltimore, Md., recently reported favorably on an ordinance authorizing the use of $60,000, appropriated for paving Charles street, to complete paving McCulloh street with asphalt blocks.

Petitions have been circulated at Appleton, Wis., asking for the paving of one block between Oneida and Appleton streets, and Harris, Fisk, Edwards, and Unions streets, and Postoffice alley.

Howard Teasdale, city clerk at Sparta, Wis., writes that the city council has ordered the paving of one thousand feet of the main street in the city with cedar blocks, with stone curb and gutters.

Syracuse, N. Y., proposes to pave the following streets with Trinidad sheet asphalt: Lock street, 2,760 square yards, $8,700; Slocum avenue, 3,800 square yards, $12,160; streets around and intersecting Walnut Park, 14,170 square yards, $46,200.

A bill has been introduced in the senate, at Columbus, O., authorizing the commissioners of Franklin county to repave, with asphalt, High and Mound streets, in front of the court-house. To provide money for the improvement, the commissioners are authorized to issue notes of the county for the necessary amount, at a rate of interest not exceeding six per cent.

The bids received, at Cincinnati, O., for the improvement of Carthage pike, were rejected, May 5, and instructed the engineer to prepare new plans and specifications to be submitted to the board of county commissioners. The work will be readvertised.

CONTRACTS TO BE LET.

Bids are invited by W. H. Brickel, Jr., Bond Hill, O., until June 4, for improving Oakland and Forest avenues.

Bids are invited at Belleville, Ill., until June 2, for paving with brick 1,251 feet of Main street. F. W. Puderer, city clerk.

Sealed bids are invited at South Bend, Ind., until June 11, for grading and graveling La Porte avenue. L. A. Hull, city clerk.

Sealed proposals are invited at Fostoria, Ohio, until June 5, 1894, for paving certain streets with vitrified paving brick. Jacob M. Shatzel, city clerk.

Bids are invited until June 12, 1894, for an asphaltic pavement on south Center street, at Schenectady, N. Y. Lewis B. Sebring, city engineer.

W. E. Bowsher, Upper Sandusky, Ohio, invites bids until June 5, for the construction of about two and a quarter miles of piked or improved road.

L. A. Hull, city clerk at South Bend, Ind., invites bids until June 11, 1894, for paving sidewalks with brick and curbing sundry streets with cement.

Sealed proposals will be received by A. W. Miller, city clerk at Sandusky, O., until June 18, for paving with brick, Market street from Wayne to Warren street.

Bids are invited until June 2 by the board of public works at Des Moines, Iowa, for paving sundry streets with brick, on sand foundation, and for cement curbing.

S. M. Stamats, village clerk at Bellefontaine, Ohio, invites bids until June 2, 1894, for paving 238 lineal feet of Columbus avenue and 317 lineal feet of Main street.

Sealed proposals will be received until June 11, at South Bend, Ind., for paving with brick and curbing with cement the roadway of La Porte avenue from Washington street to the north line of Linden avenue. L. A. Hull, city clerk.

Sealed proposals will be received until June 2, at Kansas City, Mo., for paving Seventh street from the west line of Garfield avenue to the west line of Brooklyn avenue; also, for paving Thirteenth street from Walnut street to Grand avenue. Bids will be received the same date for curbing Seventh street from the west side of Garfield avenue to the west side of Brooklyn avenue.

Sealed proposals are invited by C. B. Holmes, city clerk at Urbana, Ill., until June 11, for sewering, grading, graveling, curbing, and paving with brick the following described streets in said city, to wit: The Bloomington road, commencing at the iron bridge over Bone Yard branch and running thence westerly to the west side of Lincoln avenue: And White street from west side of Lincoln avenue extending west to Romine street: And that part of Elm street from the west side of Market street to the east side of Race street. This includes about two miles of brick paving.

Sealed proposals will be received, at Cincinnati, O., until June 12, 1894, for four pieces of work, as follows: Macadamizing the roadway of Madisonville avenue, from the west line of the Grandin road to Lauretta B. Gibson's northeast line, and setting and resetting curbs, crossings and gutter flaggings; macadamizing Northside avenue, from Whitefield street to Morrison avenue, and setting curbs and crossings, flagging and paving gutters; macadamizing Madisonville avenue, from the west line of Vista avenue to the north corporation line, and setting and resetting curbs, crossings and gutter flaggings; macadamizing Madisonville avenue, from Woodburn avenue to Hine's west line, and setting and resetting curbs, crossings and gutter flagging. August Herrmann, president board of administration.

CONTRACTS AWARDED.

The contract for paving, with brick, sundry streets in Waterloo, Iowa, was awarded to Henry L. Wheelan, of Rock Island, Ill.

The street commission at Hudson, N. Y., awarded to the Hastings Paving Company the contract for putting down asphalt blocks, at $2.50 per yard.

McCready and Rosser, of Braddock, Pa., secured the contract for paving Lincoln avenue, Bellevue, Pa., with one layer of brick, at a total cost of $30,295.

The contract for constructing an asphaltic pavement on Scio street, Rochester, N. Y., was awarded to the Rock Asphalt Pavement Company, at $8,057.10.

The Purington Paving Brick Company, at Galesburg, Ill., secured contracts for furnishing Cedar Rapids, Ia., with 3,500,000 bricks and Moline, Ill., with 1,000,000 bricks.

The contract for paving two streets at Saratoga Springs was awarded Costello & Neagle, of Elmira, N. Y. The contract calls for more than 7,000 yards of paving and will cost $30,000.

The Warren-Scharf Asphalt Co. was awarded the contract for an asphaltic pavement on the portion of Walnut street extending from the railroads south to Williard street, at Muncie, Ind.

The contract for constructing 31,500 square yards of cedar block pavement at Crown Point, Ind., was awarded to the Garden City Paving and Post Company, of Chicago, Ill., at $1.41 per square yard. The work will begin about June 1.

Udo Hesse, Saginaw, Mich., writes that bids were received May 26, for paving Washington avenue, from James street to Holland avenue, with sapless cedar blocks on concrete foundation. The contract was awarded to J. C. Danforth, of West Bay City, for $33,146.95.

The contract for a vitrified brick pavement in Ninth street, from Walnut to Cherry, at Erie, Pa., was awarded to V. D. Eichenlaub, whose bid was for metropolitan block, at $1.60 per square yard. The pavement will be constructed on a 12-inch gravel foundation.

H. A. Collar, city engineer at Grand Rapids, Mich., writes that during the month of April contracts for street improvements were awarded as follows: Ethel avenue, $1,368; Butterworth avenue, $10,997; Chubb street, $1,200; Olive street, $1,500; south Ionia street, $2,640; Richard Terrace, $1,750.

The contracts for paving the highways of Douglas county were awarded at Omaha, Neb., as follows: The west and southwest roads, which will be constructed of Nebraska limestone, on sand foundation, at about $6,200 a mile, E. D. Vancourt & Co.; the northwest road, Colorado sandstone, at $21,000 a mile, Hugh Murphy.

SEWERAGE.

The sewage disposal grounds at the outlet of the Oberlin sewer system, at Oberlin, Ohio, have been completed and are in operation.

J. Tudor Graves, city engineer at Fargo, N. D., writes that during the year, April, 1893-'94, that city built 25,439.9 feet of sewers, of all sizes, at a total cost of $40,613.35.

The section of East Side sewer, known as section No. 6, at Rochester, N. Y., was recently completed. It extends from Bowen street to the New York Central tracks, and is 6,226 feet in length and from seven to eight and one-half feet in diameter. Work was begun on the sewer April 7, 1893. Thomas F. Moore, of Buffalo, N. Y., had the contract, and expert opinion pronounces the workmanship on the sewer the best that could be accomplished.

L. E. Browne, city civil engineer at Richmond, Ind., writes that the city is experimenting with hand labor at drilling holes one and one-half inches in diameter, in blasting the trunk sewer under course of construction. The drills are six feet long and pointed at each end. The holes are drilled to a depth of four feet. Unskilled

labor has averaged two feet in ten hours per man. The only advantage gained in the experiment is that of giving employment to more men.

CONTEMPLATED WORK.

A sewerage system has been proposed for Carterville, Mo.

Sundry new sewers have been petitioned at Lowell, Mass.

A new sewerage system is declared necessary for Sacramento, Cal.

Sewer bonds, to the amount of $100,000, have been ordered issued at Melrose, Mass.

The residents of East Walnut Hills, Cincinnati, are agitating the subject of sewerage.

The council, at Wooster, O., has declared it necessary to construct a sewer in Spink street.

The plans for the sewer system at Woodbury, N. J., have been made by Parker N. Black, of Asbury Park, N. J.

An ordinance has been passed at Paterson, N. J., providing for the construction of sewers through sundry streets.

New sewers have been ordered, at Appleton, Wis., in Second avenue, Atlantic, Hancock, Richmond and Packard streets.

The committee on construction and repairs, at Fall River, Mass., has voted to recommend sewer construction in several streets.

The estimated cost of the proposed extension of the Greene avenue sewer, Brooklyn, N. Y., which will drain the Bedford district, is $494,000.

The construction of a sewer, nearly four miles long, and the greater part of which is four feet in diameter, will probably be begun at Grand Rapids, Mich., this summer.

The city council of Youngstown, O., has passed a resolution declaring it necessary to construct a sewer in Oak, Watt, Adams and Walnut streets, and in east Rayen avenue.

Surveys and designs for the system of sewers at Pittston, Pa., are being made by Potter & Folwell, of Pittsburg. Several miles of main sewers will be constructed this year.

A plan has been proposed, at Waverly, N. Y., which provides for a better system of sewerage. It is to lay a sewer pipe along the Erie tracks to Shepard's creek, to carry off surface water, leaving the present sewer for all other purposes.

C. A. Ellis, city engineer at Kansas City, Kan., recently submitted plans for a sewer to run north from Fifth street and Jersey creek to Edgerton place. The estimated cost of the construction is $12,000. Plans are also being made for smaller sewers for different parts of the city.

Syracuse, N. Y., proposes to construct the following sewers: 1,440 lineal feet 18-inch tile and 1,480 lineal feet 15-inch tile sewers in W. Genesee street. Estimated cost is $5,625; 130 lineal feet 12-inch tile in Grace street. Estimated cost $240.

J. Alcide Chausse, Montreal, Can., writes that the city proposes to construct sewers on Chicago and Duluth avenues. He writes, also, that the city council at Winnipeg, Man., will build sewers on Selkirk, Flora and Salter streets, at an estimated cost of $16,000.

The sewerage commission, at Hamilton, O., recently recommended the immediate construction of storm sewers in the fifth ward, on Wood and Ross streets, and on Milville and Park avenues; a sanitary main sewer along Front street and the river to Seventh street, and sanitary sewers in High, Main, Front, Second and Third streets, and on South avenue.

The sewerage question is being agitated at Westfield, N. J. F. A. Dunham, of Plainfield, N. J., who was consulted regarding it, estimates the cost of a sewer to tide water, at about $9,000 per mile and the cost of lateral sewers at $5,000. This would make the total cost about $90,000, while the filtration system would cost between $30,000 and $40,000. The filtration system is favored.

CONTRACTS TO BE LET.

L. A. Hull, city clerk at South Bend, Ind., invites bids until June 11, 1894, for the construction of a pipe sewer.

Sealed proposals will be received until June 5 at Chicago, Ill., for constructing sewers in sundry streets and avenues.

Bids are invited until June 2, at Des Moines, Ia., for putting in a 12-inch pipe sewer in Terrace Road. Address John Sherman.

Bids are invited at Bucyrus, Ohio, until June 5, for the construction of a sewer in lateral sewer district No. 3. W. A. Blicke, city clerk.

Sealed proposals will be received until June 13 at Cleveland, O., for the construction of sewers in sundry streets. Clerk of board of control.

Bids are invited until June 1, at Frankfort, Ind., for the construction of a main sanitary sewer, about 9,500 feet in length. James A. Price, city clerk.

Sealed proposals will be received by Geo. S. Hoyt, captain and assistant quartermaster U. S. Army, Helena, Mont., until June 9, 1894, for the construction of the sewer system at the new post of Fort Harrison, near Helena. The system comprises about 11,000 feet of pipe, 30 man-holes and flush tanks.

CONTRACTS AWARDED.

The contract for the Glen avenue sewer in Amsterdam, N.Y., was awarded to Strain & Cassidy for $2,663.30.

Thomas Tole, of Rockford, Ill., secured the contract for constructing sewers in the Fifth street sewer district, in that city.

The contract for constructing eight miles of sewer at Peoria, Ill., was awarded to Robert Clark, of that city, at $30,187.30.

The contract for constructing a sewer system at Kittanning, Pa., was awarded to Harrison & Sons, Newark, N. J., for $26,357.

The contract for sewers in District No. 2, Athens, Ga., was awarded to McPoland and Buckhalter, Birmingham, Ala., at their bid of $8,110.03.

Browder & Shover were awarded the contract for paving with brick, South Meridian street, Indianapolis, Ind. The contract price is $8.08 per lineal foot.

The contracts for sewer construction at Paterson, N. J., were awarded to Robert Downie, with the exception of one which was awarded to James Collins. The contracts numbered fourteen in all.

The board of public works at New Haven, Conn., recently awarded contracts for the construction of new sewers as follows: Goffe street, $1,753; East Pearl street, $2,261; Nicoll street, $1,870; Day street, $1,758; Cedar street, $556, and Clay street, $455.

The contract to furnish supplies for the northern half of the Patapsco sewer, at Baltimore, Md., was awarded to the lowest bidder in each instance, as follows: Sand, C. H. Elliott; stone, J. T. Curley & Co.; sewer blocks, Freaney and Peach; brick, Smith and Schwartz; cement, National Building and Supply Company and J. Bullock and Son; lumber, P. M. Womble.

The city engineer at Grand Rapids, Mich., H. A. Collar, writes that sewer contracts were awarded during the month of April, as follows: South Feller street, 1,762 feet, $1,475; West Division street, 239 feet, $140; Sixth avenue, 642 feet, $572.46; Oakdale avenue, 1,020 feet, $771.31; Jefferson avenue, 1,656 feet, $744; Dunham street, 928 feet, $486; Jackson and Valley streets, 1,553 feet, $1,110.

McNerney & Moore, of Muncie, Ind., were the lowest bidders for the construction of sewers at Frankfort, Ind. Their bid was as follows: Storm sewer, 30-inch vitrified tile, $2.29 per foot; 30-inch two-ring brick, $1.94 per foot; man-holes, each $25. Sanitary sewers, 12-inch vitrified tile, 61¾ cents per foot; 10-inch vitrified tile, 52½ cents per foot; 8-inch vitrified tile, 38 cents per foot; 4-inch vitrified tile, 20 cents per foot.

Contracts for sewers have been let in Syracuse, N. Y., as follows: 750 lineal feet 15-inch tile and 630 lineal feet 12-inch tile sewers in Sand street and Belden avenue, to Martin Lavelle for $1,528; 1,020 lineal feet 18-inch tile sewers and 1,020 lineal feet 15-inch tile sewers in E. Genesee street, to P. H. Harrison & Sons, of Newark, N. J., for $4,204; 570 lineal feet 15-inch tile sewers in Hickory street, to Frank Nett, for $1,383.80; 800 lineal feet 15-inch tile and 250 lineal feet 12-inch tile sewer in Cortland avenue, for $1,139, to Richard Barrington; 280 lineal feet 18-inch tile sewer in McBride street, to L. D. Hulbert, for $626.

WATER-WORKS.

The water-works system at Onalaska, Wis., will be completed by August 15.

When completed, the new water main extension which is being made at Bangor, Me., will be 13,300 feet long.

The plans that have been made for the water-works system at Columbia City, Ind., are considered inadequate by the citizens, especially in the northern part of the city, where the mains do not extend. The citizens had expected to expend $30,000 or $35,000 for the system, but the estimated cost, as shown in the plans, is $24,400.

CONTEMPLATED WORK.

Lake Ann, Mich., wants water-works.

Elkhorn, Wis., will have water-works.

Carey, O., recently voted in favor of water-works.

Milford, Ia., is agitating the question of water-works.

Water-works are being agitated at Chesaning, Mich.

Water-works are again being agitated at Savannah, Ill.

Louisville, Colo., contemplates a system of water-works.

A water-works system has been proposed at St. James, Mo.

A system of water-works is contemplated at Edgerton, Wis.

A system of water-works is contemplated at Forsythe, Ga.

Oceanside, Cal., will probably have a system of water-works.

The question of water-works is receiving consideration at Tomah, Wis.

The citizens of Weston, W. Va., are agitating the water-works question.

Dodgeville, Wis., contemplates the construction of a system of water-works.

A petition is in circulation at Newton, N. J., to bond the city for water-works.

A water-works system, at an estimated cost of $13,500, is contemplated at Genesee, Idaho.

Plans are being prepared for a new system of water-works for Fort William, Ont. Estimated cost, $62,000.

F. L. Neiderheiser, Ashland O., writes that there is still considerable talk of water-works in that city.

The question of issuing bonds for $18,000 for water-works was favorably voted on, May 7, at Snow Hill, Md.

Plans have been prepared for systems of water-works at Vandalia, Ill., by Hiram Phillips, C. E., of St. Louis, Mo.

The city council at Rollingstone, Minn., contemplates the purchase of ground for the purpose of erecting water-works.

Winnebago City, Minn., recently voted $5,000 bonds for a pumping station and to complete the water-works system.

It has been suggested at Hazleton, Pa., that the city build water-works that will keep pace with the growth of the city.

Plans for the proposed system of water-works at Lunenburg, Ont., have been prepared by J. A. Pickett, C. E., of New Glasgow. The estimated cost is $70,000.

Oak Cliff, Tex., wants a system of water-works, and will furnish bonds for one-half the cost of the work and take stock in the water-works for the same. E. W. Foster, mayor.

The water-works proposition, at Buckhannon, W. Va., was defeated in the council by one vote, but it will be submitted to a vote of the people, with better results it is hoped.

The exorbitant water rates of the present company, at Crawfordsville, Ind., has caused a great deal of dissatisfaction. New water-works, to be owned by the city, have been proposed.

A loan of $100,000 has been authorized at Northampton, N. H., for the enlargement of the city water-works. A new reservoir will be built, with a capacity of 100,000,000 gallons of water. The remainder of the money will be used in laying additional water mains.

CONTRACTS TO BE LET.

Bids are invited until June 15, at Barron, Wis., for a complete system of water-works.

The city of Roodhouse, Ill., will receive bids for water-works. Address, George W. Armstrong, mayor.

Bids will be received at Kingsley, Iowa, until June 6, for the construction of a system of water-works.

Bids are invited by the village council at Lamberton, Minn., until June 20, for a complete system of water-works.

Bids are invited by E. M. Bigelow, director of department of public works, Pittsburg, Pa., until June 21, for furnishing a quantity of water pipe, special castings, gate valves, etc.

Sealed proposals will be received until June 6, at Penn Yan, N. Y., for the construction of water-works. Proposals should be addressed to W. N. Wise, secretary of the board of water commissioners.

Sealed proposals will be received at Norfolk, Conn., until June 14, for the construction of water-works, consisting of about four miles of main line and three miles of village distribution. Edmund Brown.

Sealed proposals will be received at Helena, Mont., until June 9, for constructing a water system for the new port of Ft. Harrison, near Helena. Address, George S. Hoyt, Capt. and A. Q. M., U. S. Army.

The board of city commissioners at Key West, Fla., will receive bids for furnishing plans and specifications, and for furnishing the material necessary for the construction of a complete system of water-works for the city.

Sealed proposals will be received until June 5, at Hutchinson, Minn., for the construction of a system of water-works. Plans and specifications can be seen at the offices of A. Ritter, village recorder, Hutchinson, and Chas. F. Loweth, 94 East Fourth street, St. Paul, Minn.

The time for receiving proposals for the system of water-works at Danville, Ky., has been extended from May 30 to Friday, June 8. Plans and specifications can be seen at the offices of the water committee at Danville, or Chester B. Davis, consulting engineer, 1627 Monadnock Building, Chicago, Ill.

CONTRACTS AWARDED.

The contract for the new water-works at Marcellus, Mich., was awarded to Munn & Andrews, of Dowagiac, at $7,748.

The Fremont Foundry and Machine Co., Fremont, Neb., secured the contract for the new water-works at Griswold, Ia.

C. W. Hubbard & Co., Sioux Falls, S. D., secured the contract for putting in a water-works plant at Dell Rapids, at $11,000.

The contract for constructing the water-works at Sheldon, Ia., was awarded to W. H. Wheeler & Co., of Beloit, Wis., at $19,800.

The Addyston Pipe and Steel Co., of Cincinnati, O., presented the lowest bid for 1,000 tons of water pipe for the Youngstown, O., water-works. Their bid was $16.34 a ton.

BRIDGES.

A new bridge is to be built over the Figgins branch, near Sciola, Ia.

A bridge is contemplated across the Kentucky river, at Carrollton, Ky.

A wagon bridge will be built across the L'Anguille river, at Marianna, Ark.

A new iron bridge will be constructed across Bear creek, near Marengo, Ia.

The wooden bridge at Sykesville, Md., will be replaced by an iron structure.

The bridge over the Mississippi river at Alton, Ill., was formally opened May 1.

R. P. St. John, Clear Lake, S. D., invites bids until June 4 for erecting a bridge.

A senate bill has been introduced to authorize the construction of a bridge across the Missouri river at or near Lexington, Mo.

Bids are invited by G. Cooper, Monmouth, Iowa, until June 6 for rebuilding a bridge.

The construction of a bridge is contemplated across Coon creek, near Hill City, Kan.

C. Bauermeister, New Ulm, Minn., invites bids until June 2, for building a bridge across Fort creek.

A new bridge, at St. Clair street, is proposed at Toledo, O., the present one being insufficient.

Westfield, N. Y., has voted to construct a new bridge on Main street, at an estimated cost of $15,000.

A new bridge has been proposed at Marion, Ind., to be built across the river at Washington street.

J. Alcide Chausse writes that the iron bridge recently swept away at Cassellman, Ont., will be reconstructed.

Bids are invited, until June 9, for a bridge across the Des Moines river at Fort Dodge, Ia. T. Cunningham, auditor.

A bridge will be reconstructed across the Niobrara river, near Niobrara, Neb. A bill has been signed to that effect.

The sum of $18,000 has been appropriated for the construction of a new iron bridge over Cedar river, at Muscatine, Ia.

The iron superstructure of the Franklin street bridge, at Evansville, Ind., has been accepted by the county commissioners.

An act, authorizing the construction of a bridge over the St. Louis river, at West Duluth, Minn., has been approved by the president.

The contract for building bridges during the year, in Minnehaha county, S. D., was awarded to S. M. Hewitt & Co., of Minneapolis, Minn.

The contract for the iron draw bridge across the canal at Little Chute, Wis., was awarded to the Wisconsin Bridge and Iron Co., for $2,200.

Property-owners along the Bellefontaine road, at St. Louis, Mo., are protesting against the construction of the proposed bridge at Bircher avenue.

The city engineer at Toronto, Can., has been instructed to prepare an estimate of the cost of constructing the proposed high level bridge over the Don.

A bill has been passed authorizing the city of Dayton, O., to issue $12,000 in bonds for the purpose of building a bridge over the canal at Warren street.

The contract for building the sub-structure of the wagon bridge across the Mississippi river at Red Wing, Minn., has been awarded to D. D. Smith, of St. Paul.

Proposals are invited by the county commissioners at Gettysburg, Pa., until June 12, on a new bridge over Marsh creek at Bigham's Fording. The span is to be 160 feet.

The county board, Elkhart, Ind., recently met to consider the construction of a new bridge at the township line between Concord, Osolo and Washington townships.

A new bridge is proposed at Main street, Dayton, O. The estimated cost is $50,000. A bridge across the Miami river, to connect Apple and Albany streets, has also been petitioned.

The Combination Bridge Company has been incorporated at Sioux City, Ia., with a capital stock of $2,500,000, to complete the combination wagon and railroad bridge across the Missouri river.

The Wrought Iron Bridge Company, Canton, O., was awarded the contract for the McClure bridge across the Portage river, between Henrietta and Leoni, Mich. The bridge will be 70 feet long.

Bids for iron, wood and combination bridges, to be built during the season, will be received at Fort Madison, Ia., until June 4. J. F. Daugherty, chairman; John Walljasper, county auditor.

A report will be given in September, at Sunbury, Pa., upon the proposed bridges across the Susquehanna river, between Herndon and Port Trevorton, and at McKee's Half Falls, Snyder county.

O. R. Rauchfuss, city engineer at Joliet, Ill., writes that the contract for masonry for the Wheatland bridge was awarded to A. Wenberg, Joliet, at $6 per yard. The contract for the superstructure was awarded to R. C. Morrison, Joliet, for $3,125.

The county clerk, at Kansas City, Kan., invites bids until June 2, for the construction of the bridge over the Kaw river at Turner. The structure will be an iron highway bridge with four spans resting on masonry piers. The estimated cost is $53,000.

Bids will be received, at Hawkinsville, Ga., until June 13, for placing two sixty-foot iron spans in place of the present wooden approaches to the draw bridge across the Ocmulgee river, in Pulaski county. Address, P. T. McGiff, Ordinary, Pulaski county.

The commissioners of Kent and Queen Anne counties recently received the report of the civil engineer appointed to make an examination of the draw bridge which spans the Chester river at Chestertown, Md. It will cost $10,000 to rebuild. Definite action has not yet been taken.

The new iron and steel bridge to be built across the Boone river, at the east end of Second street, Webster City, Ia., will be one of the finest in the county. The bridge will have two spans of 120 feet each; two center piers will be five feet in diameter, and the end piers will be four feet; the roadway will be twenty feet wide, with a foot walk, five feet wide, on each side. The cost of the bridge is estimated at $8,000.

Sealed proposals will be received, at Mansfield, O., until June 9, for furnishing the necessary labor and material for constructing an arch over Ritter's run, on East Second street. Each bid must be submitted in amount per lineal foot and for a 43-foot section. Address E. T. Cook.

Four new bridges were recently ordered built in Cass county, Mo., as follows: East Lynn bridge, one and one-half miles northeast of East Lynn; Hewitt bridge, on Eight Mile road; Walkley bridge, in Camp Branch township, and the Sugar creek bridge, in Dayton township. A number of other bridges will be constructed as soon as the specifications are prepared.

A number of new bridges will be erected in Mill Creek Park, at Youngstown, O., this summer. A new steel arch bridge 90 feet long will be built across the Cascade ravine, on the west side of the park, about a mile north of Lanterman's falls. A suspension bridge will be built over Mill creek, at Manning cliffs, about one-half mile north of Lanterman's falls. An iron truss bridge, 50 feet long, will be constructed in the west side of the park. In addition to these, five stone arches will be erected across ravines and small streams.

PUBLIC PARKS.

A park is proposed for Bloomington, Ill.

A loan of $80,000 for park purposes, has been authorized by the aldermen, at Malden, Mass.

A new park is to be established, at Winona, Minn., on the adjacent grounds of the ladies' seminary.

The Walnut Grove park, at Kansas City, Mo., will be improved by the board of park and boulevard commissioners.

Mr. George E. Kessler, Kansas City, Mo., has been engaged to design a plan for a park, at Carthage, Mo., by which future improvements can be made in a systematic manner.

Spring street, between Tenth and Eleventh streets, Spokane, Wash., is to be parked. A uniform system of parking residence streets is to be introduced, to be under the supervision of the city department.

STREET RAILWAYS.

An electric railway is contemplated at Mt. Pleasant, Ia.

The Joyce Park line, at Clinton, Iowa, is to be converted into an electric line.

An electric railway is proposed from Springfield through Riverdale to Holyoke, Mass.

The Marion (Ind.) Street Railway Company has been granted a franchise at Gas City, Ind.

An electric street railway is to be constructed between Towanda and Wellsborough, Pa.

The street railway at Jacksonville, Fla., is to be extended and converted into an electric road.

An electric railway line is talked of at Ashland, Ohio, to extend from Ashland to New London.

A company is being formed to construct an electric railway between Washington, D. C., and Manassas, Va.

The Alton Electric Street Railway Company, Alton, Ill., contemplates the construction of ten miles of street railway, to be run by electricity.

A franchise to build and operate an electric street railway, has been applied for by the C. L. Centliever Street Car Company, at Fort Wayne, Ind.

Murray Brothers, New Brunswick, N. J., secured the contract for laying thirty miles of track for the Brooklyn, Queens County and Suburban Railroad Company.

W. J. Richie was recently granted a franchise to construct, maintain and operate a street railway route on Wayne, Charles and Cole streets and Rice avenue, in the city of Lima, Ohio.

Bids will be opened August 1, for constructing and operating a system of electric tramways in Cairo, Egypt and its environs. Address, Frederick C. Penfield, United States Agent and Consul-General.

MUNICIPAL BONDS.

W. H. Kelly, Lewiston, Mont., invites bids until June 4, for the purchase of $53,000 of six per cent. bonds.

W. E. Wichgar, Norwood, Ohio, invites bids until June 19 for the purchase of $53,000 of 6 per cent. bonds.

W. J. Dowler, city clerk at Victoria, B. C., invites bids until June 18, for the purchase of $55,000 of bonds.

Bids will be received by the county auditor at Indianola, Iowa, until June 4, for the purchase of $20,000 of bonds.

T. V. Brennan, Dakota City, Neb., invites bids until June 8 for the purchase of $120,000 of 4½ per cent. county bonds.

Bids are invited by A. W. Miller, Sandusky, Ohio, until June 11, for the purchase of $45,000 of five per cent. bonds.

Bids are invited by J. T. Van Hoene, Covington, Ky., until June 15, for the purchase of $88,000 of four per cent. bonds.

J. H. Pheatt, city auditor at Toledo, Ohio, invites bids until June 11, for the purchase of $45,000 of four and one half per cent. bonds.

Bids are invited by the city controller at Detroit, Mich., until June 4, for the purchase of $100,000 Detroit sewer bonds. C. W. Moore, controller, City Hall.

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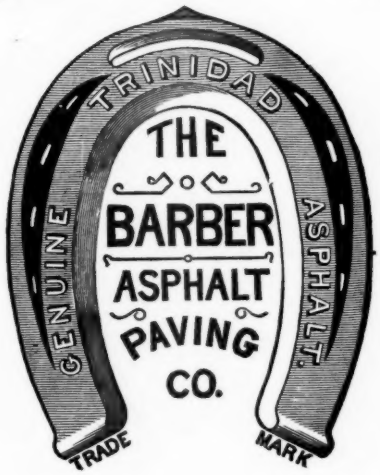

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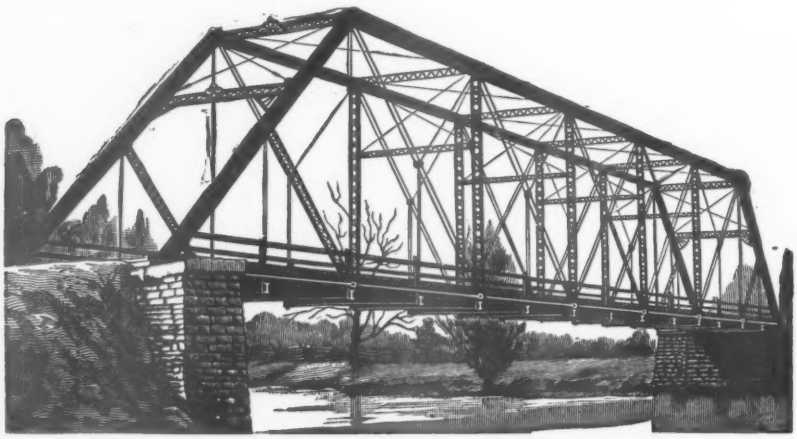

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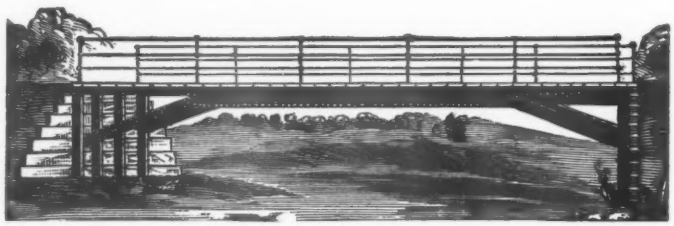

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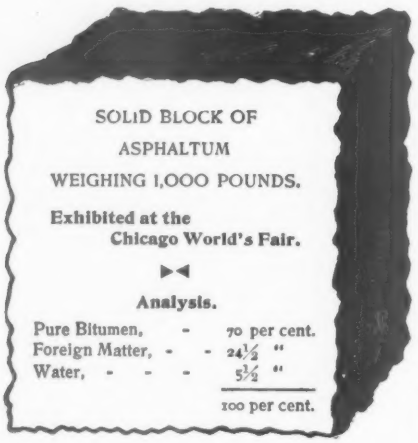

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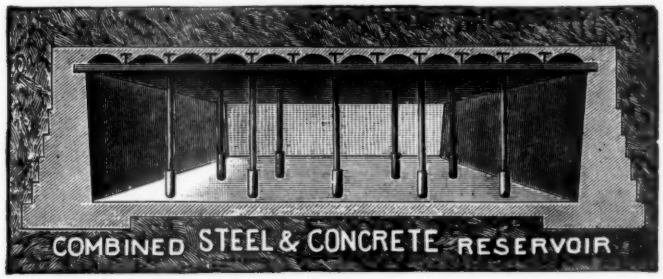

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No. 7—Bermudez	453 pounds.	No. 14—Bermudez	537 pounds.

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Briquettes.	Tensile Strength.	Briquettes.	Tensile Strength.
No. 3—Trinidad	53 pounds.	No. 10—Bermudez	130 pounds.
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TEMPERATURE 108°

Briquettes.	Tensile Strength.	Briquettes.	Tensile Strength.
No. 5—Trinidad	20 pounds.	No. 12—Bermudez	28 pounds.
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2 in. Cubes.	Pounds.	Size of specimen after pressure.
No. 20—Trinidad	4,110	1½ in.
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No. 24—Bermudez.	7,000	1⅝ in.

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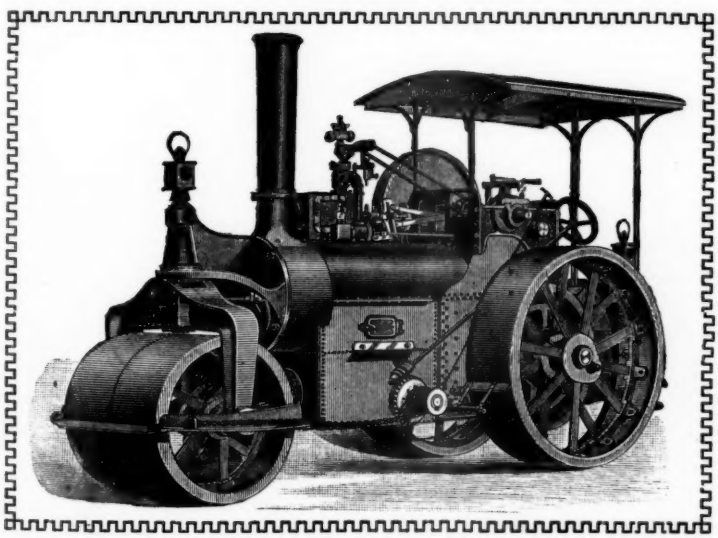

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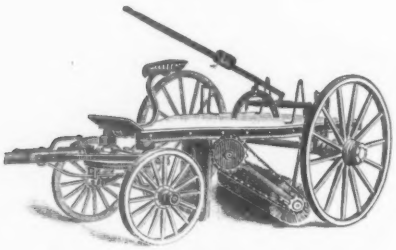

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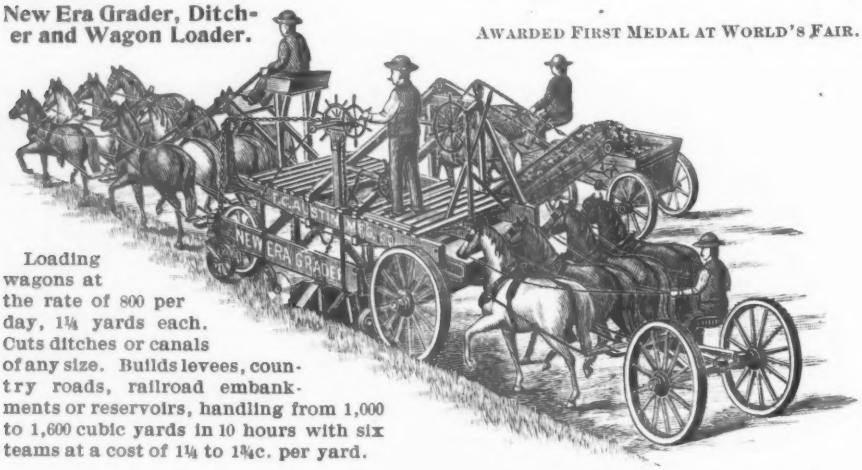
New Era Grader, Ditcher and Wagon Loader.



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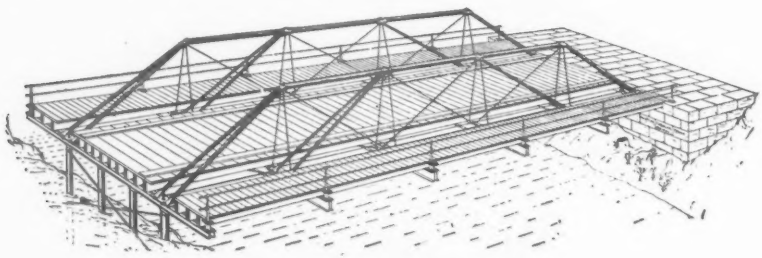

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The combination of a tubular truss thoroughly braced with heavy I-beam steel girders, supported on stone abutments or tubular piling, provides counties and townships a substantial and permanent bridge at reasonable cost. Send specifications.

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ARE THE CHEAPEST TO BUY AND THE MOST DESIRABLE TO USE.

Not because they cost the least, but for the reasons given below: The Steel Champion is more simple in construction and more easily operated than any other. It will effect a saving of from 50 to 75 per cent. over any other method of making and repairing dirt roads and streets.

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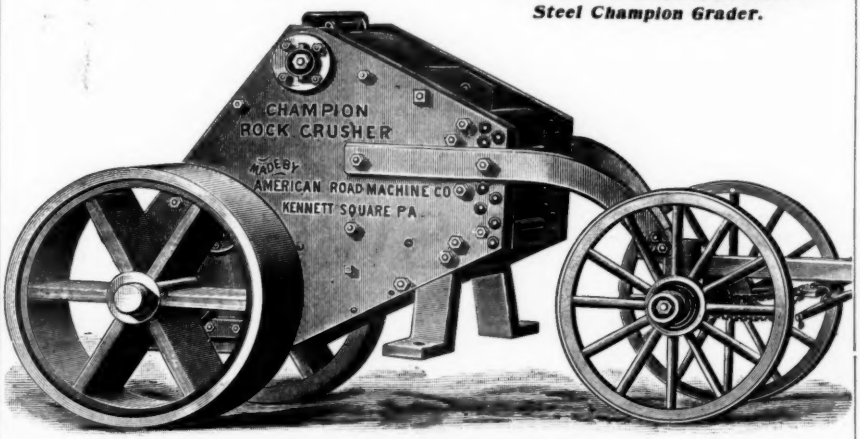
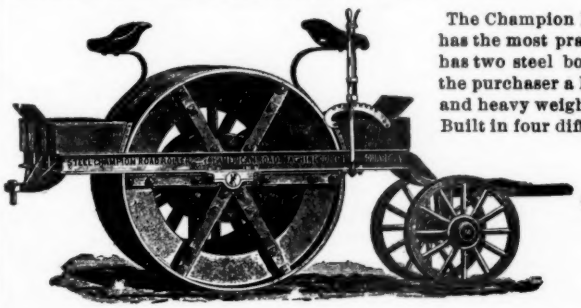


The Champion Steel Rock Crusher.

The Champion Steel Rock Crusher is built almost entirely of steel and is therefore light in weight but strong, durable and efficient. It produces the greatest amount of product with the least consumption of power. Costs less for repairs, and being portable on its own flywheels, is easily and cheaply moved from place to place.



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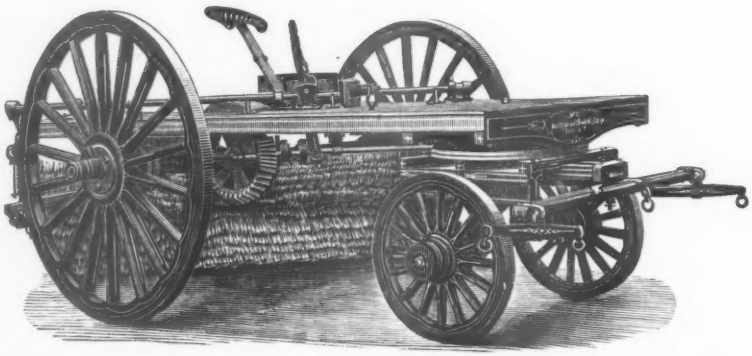

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The Board of Street and Water Commissioners.

NEWARK, N. J., February 23d, 1894.

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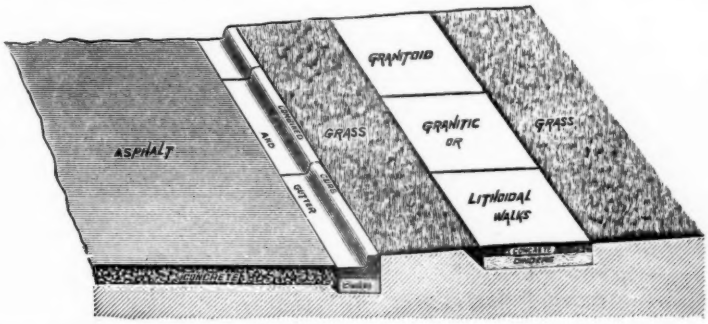

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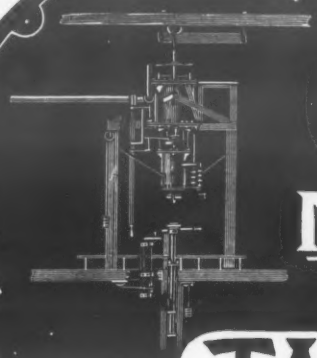

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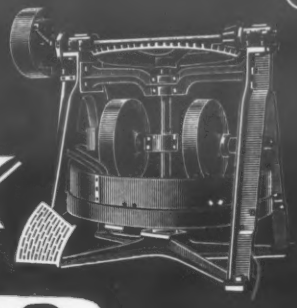

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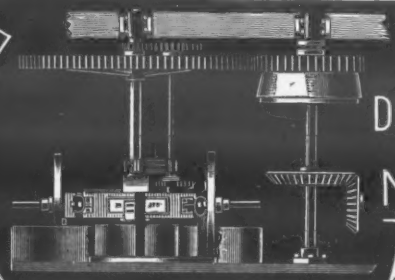

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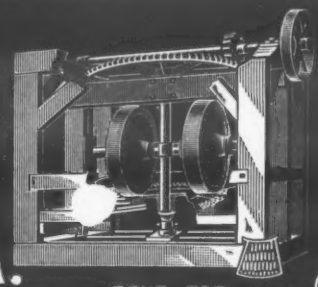

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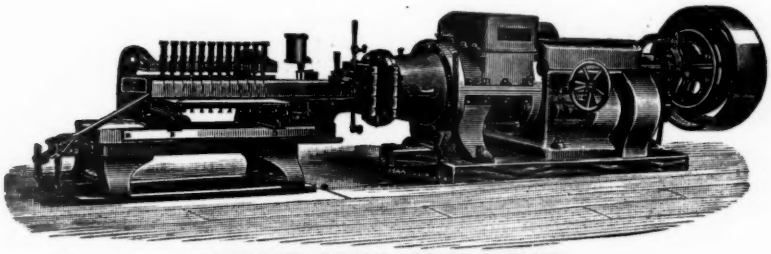

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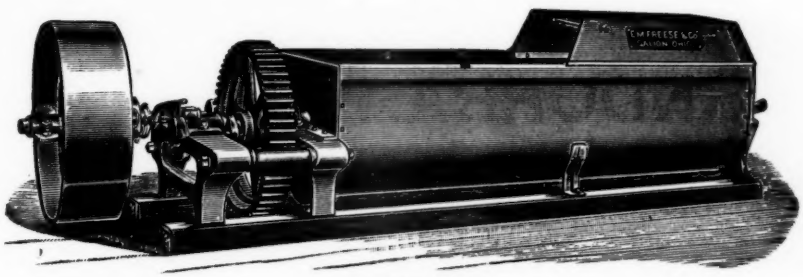

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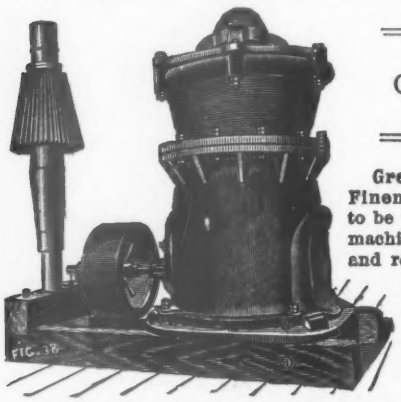

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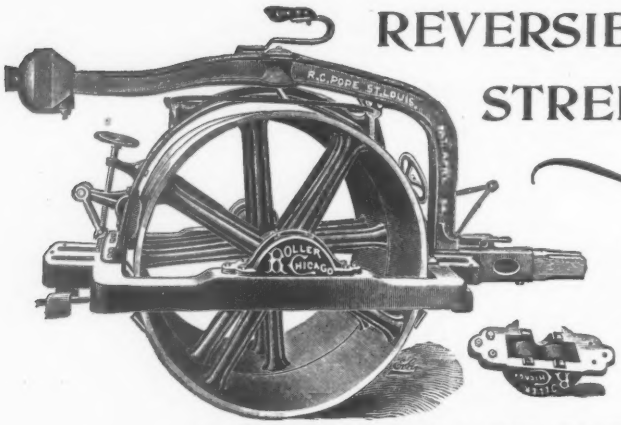

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Explodes the old theory that heavier rollers produce better results.
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Anti-friction roller bearings reduce the horse power 25%, explains why the five-ton roller has built 75% of the best brick streets.
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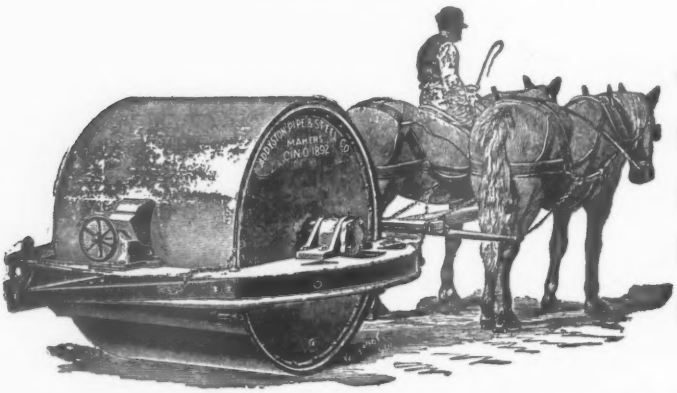

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Axle moves in roller bearings. Weight can be increased by filling with water. Solid heads give strength. The tongue can be quickly reversed, without detaching. We make all weights and sizes. Write for prices.

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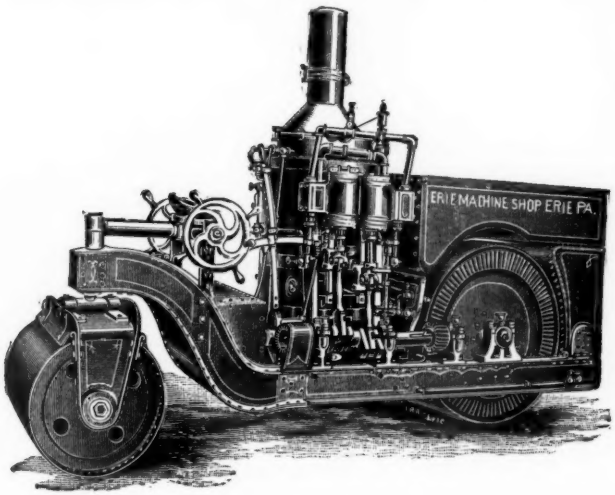

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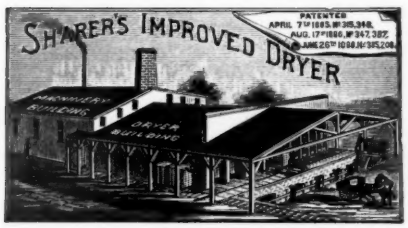

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Excellent Work—One brick never touches the other to mar it in going through the machine.

The feeding capacity is large—Room for four bricks to be placed while two are being pressed.

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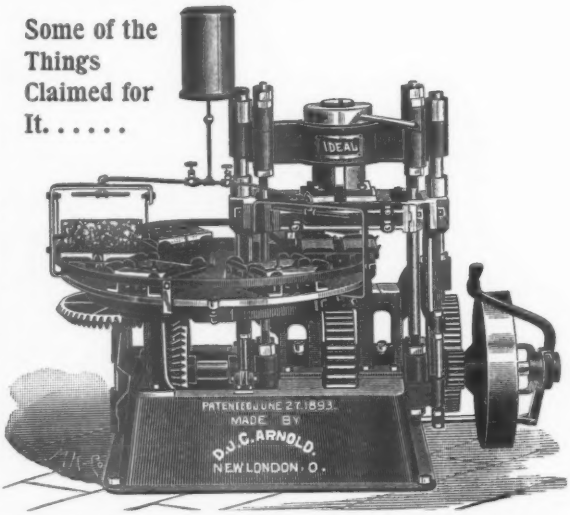

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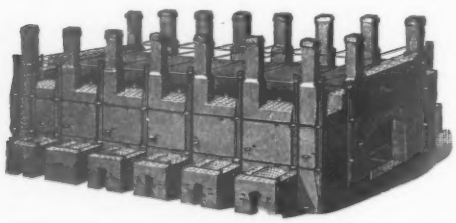

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THIS is a Down-Draft Kiln, built either round or square, and of any desired size.

These Kilns are better adapted to a large output than any kiln in use where all hard brick is desired.

The Kiln is peculiar in this: THE CONSTRUCTION is such that the heat can be driven to any part of the kiln at will.

While this is a DOWN-DRAFT-KILN, a PART of the HEAT can be TAKEN to the wares in the BOTTOM DIRECT when desired.

It has no equal for ALL HARD BRICK AND UNIFORMITY IN BURNING.

The Round Kilns, while built on the SAME PLAN OF CONSTRUCTION as the SQUARE KILN, is better adapted to plants of SMALLER DAILY capacity, and especially SEWER PIPE and FIRE BRICK.

Having built a large number of plants, we are warranted in offering this system on a very high guarantee. We make a specialty of laying out and building press brick and street paving brick plants. Address,

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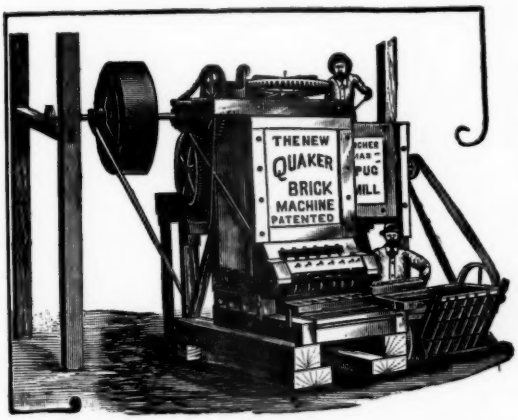

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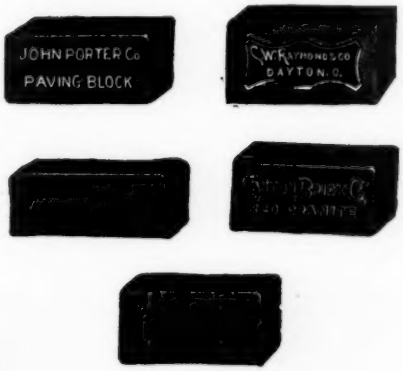

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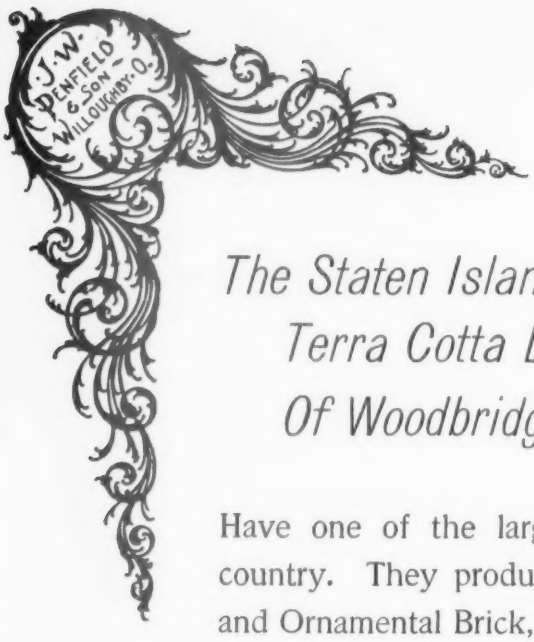

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"We have thirty machines of the Penfield pattern for various purposes now in operation in our plant. Without exception, every machine gives perfect satisfaction. They are in daily operation.

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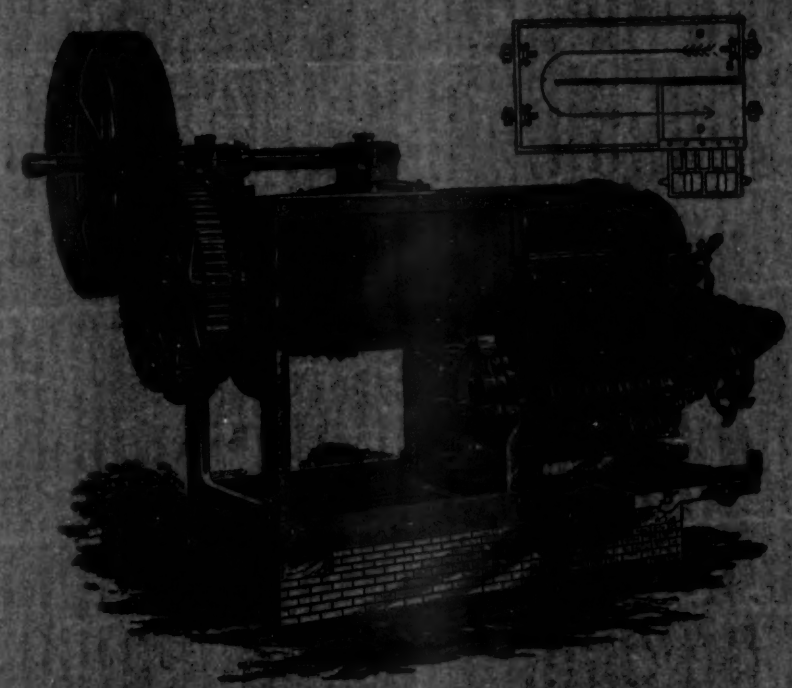

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It has the greatest tempering capacity (14 feet of pug-mill).

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It is the strongest, handiest, easiest running, most compact and simplest.

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